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The Electric Railway at Milwaukee.

A correspondent of the Grand Rapids, Mich., *Eagle*, describes the Milwaukee electric road from his point of view as follows:

"Electric railways are interesting the citizens of Grand Rapids to a greater or less degree. It was my pleasure to visit Milwaukee, recently, and ride over a newly-equipped electric line, and I want to say that I was well pleased. Electricity has worked many wonders, but it never did a more wonderful thing than the way in which it has awakened the business interests of this city. In this line the overhead system is used; and while the big copper wires and iron posts were at first objected to as not ornamental, the company is forgiven now for all its doings, on account of the fact that they make the cars "get there" in such excellent style. The mule, which was allowed all the time he desired to transport the passengers across the city, is now allowed to bray in another line of duty. A surprising rate of speed is attained, and yet, seemingly, the cars are under perfect control. Cars run up and down the grades with steady and never-flagging speed, and they occasionally run a little too fast. The ordinances do not provide for the rate of speed, and there are fears, at times, that some sad accident will occur when it is too late to remedy it. But the driver, if it becomes necessary, can simply place his hand on the little key which controls the current, and the car slows up, just as does the cable car or the horse-car aided by the brakes. Trips that formerly occupied an hour have been cut down to 40 minutes. The system has livened up business. There is a vim and dash which was wholly lacking before; and no stranger will dodge an electric car and say, "Oh! poor slow Milwaukee!" People who used to go to sleep while crossing downtown thoroughfares, now have to keep their eyes open. Where the mule train used wearily to drag the bob-tail car (and both were in use here) through the business center, stopped by some slow wanderer who was crossing the street, the electric car now goes crackling and buzzing, with a clear right of way. It's a great system of street travel, and the citizens of Grand Rapids will be delighted when they, too, can see the raw-boned horse superseded by the greatest power on earth."

Freeman's Suit Dismissed.

Judge Ingraham last week dismissed the complaint in the suit of Walter K. Freeman against the United States Electric Light Company to recover $100,000 damages for breach of contract and for a balance of salary. The suit was based on a contract with Charles R. Flint, then president of the company, by which Freeman was to receive $100,000 when the patent on his invention of the incandescent lamp was perfected, and was to be employed by the company at a salary of $50 a week pending the application for and the life of the patent. He claimed that the contract was made with Flint, as president of the company, but the Judge held that there was no evidence that Mr. Flint had authority to act for the company. As to the balance of salary, the Judge held that Freeman had virtually resigned.

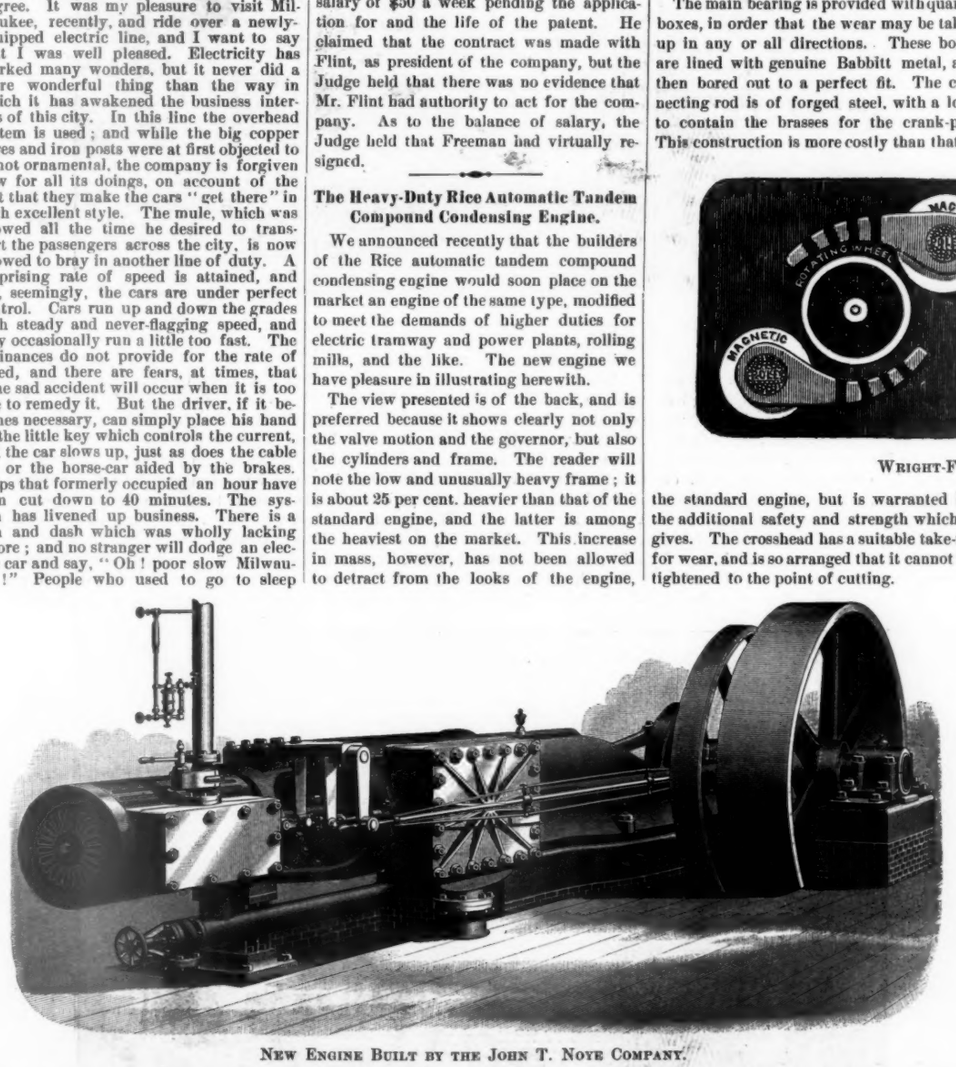
The Heavy-Duty Rice Automatic Tandem Compound Condensing Engine.

We announced recently that the builders of the Rice automatic tandem compound condensing engine would soon place on the market an engine of the same type, modified to meet the demands of higher duties for electric tramway and power plants, rolling mills, and the like. The new engine we have pleasure in illustrating herewith.

The view presented is of the back, and is preferred because it shows clearly not only the valve motion and the governor, but also the cylinders and frame. The reader will note the low and unusually heavy frame; it is about 25 per cent. heavier than that of the standard engine, and the latter is among the heaviest on the market. This increase in mass, however, has not been allowed to detract from the looks of the engine, but is distributed with such nice judgment as to give it an appearance of graceful solidity that must please every eye. Fine lines, it is true, do not make a fine engine, but, given a good engine, they will add that which must surely strengthen an already favorable impression.

With two exceptions—frame and governor—this heavy-duty Rice engine is practically identical in construction with the standard tandem compound engine already referred to. The crank disk being too small for the governing mechanism required on so large an engine, it has been found best to place the governor in the fly-wheel, or, in some cases, in a wheel of its own. The valve is then driven from a separate eccentric on the shaft; both valves being driven automatically by the governor. The valve itself is of the well-known gridiron pattern, with four ports, and is so nicely balanced that it can easily be operated by hand, even when under full steam pressure.

The main bearing is provided with quarter boxes, in order that the wear may be taken up in any or all directions. These boxes are lined with genuine Babbitt metal, and then bored out to a perfect fit. The connecting rod is of forged steel, with a loop to contain the brasses for the crank-pin. This construction is more costly than that in the standard engine, but is warranted by the additional safety and strength which it gives. The crosshead has a suitable take-up for wear, and is so arranged that it cannot be tightened to the point of cutting.



NEW ENGINE BUILT BY THE JOHN T. NOYE COMPANY.

Engineers will be particularly appreciative of the fact that in this engine the low pressure piston head can be removed without disconnecting the high pressure, and of the arrangement by which steam may be used in either cylinder without employing the other. We would also call their attention to the clearance, which is as small as considerations of safety will permit, and to the advantage which the sensitive governor gives, of considerable variation in speed.

Two engines have already been built from the new patterns; one for the South Bend Electric Light and Power Company, of South Bend, Ind., and the other for the Dakota elevator in this city. Neither of these engines has yet received the full load for which it is guaranteed; but their work so far has been of such a satisfactory character as to promise unusual efficiency, combined with that high economy which it is the aim of every good engine builder to attain, and which has always especially distinguished the Rice engines. The John T. Noye Manufacturing Company, Buffalo, N. Y., and 89 Liberty street, New York City, are the only builders of Rice engines, and all requests for information should be addressed to them or to Fairbanks, Morse & Company, their Western agents, at Chicago, St. Louis, Kansas City, Omaha, Denver and St. Paul.

WRIGHT-FERRANTI METER.

A Satisfied Tourist.

Lieut. A. B. Wyckoff has returned to his duties in Washington, as assistant in the bureau of yards and docks, having completed the inspection of a number of electric light and power plants in the vicinity of Boston, New York and Philadelphia. He expresses himself as particularly pleased with the Thomson-Houston incandescent plant for street lighting at Malden, Mass., and the Edison light and power plant at Philadelphia. The most instructive result of his trip was a careful examination of the new Thomson electric welding process as seen at their works in West Lynn, Mass. He is convinced that the process is a great success and that it is but a question of time when the electric welders will come into general use, as doing much more rapid and perfect work than manual labor. Lieut. Wyckoff's tour of inspection was made in connection with the introduction, in the near future, of electric light and power plants at several of the navy yards.

The Wright-Ferranti Alternate Current Meter.

We give, this week, a brief illustrated description of an ingenious form of alternate current meter which has recently been devised by Messrs. Arthur Wright and S. Z. de Ferranti. The meter was described by Dr. Fleming at the end of his interesting lecture at the Society of Arts, on Wednesday evening, and it forms a beautiful practical application of the principles underlying Prof. Elihu Thomson's remarkable experiments.

In the accompanying figures we have a rough diagrammatic representation of this meter. It consists, in its latest form, of a pair of vertical electro-magnets, the magnets having divided iron cores. To the poles of these magnets are attached curved horns of divided iron which lie in a horizontal plane. These curved horns are magnetically throttled at intervals along their length with copper bands. The curved horns embrace a circular space in which can revolve a light copper or iron shallow cylinder of thin metal. This cylindrical band forms the periphery of a light wheel, capable of rotation on a vertical axis. Geared to this axis is a counting mechanism; the axis also carries a vane having mica blades.

The electro-magnetic principle, said Dr. Fleming, may be briefly described thus:

The throttling of the curved iron horns causes the rapidly reversed magnetism to take the form of a lateral diffusion of lines of force from the sides of the horns. In effect a series of oppositely-named magnetic poles travels along the horn from the base, where it is in contact with the top of the electro-magnet, to the tip. These poles are represented by a series of bunches of lines of force, setting out laterally from the sides of the horn, and traveling up it. The lateral passage of these lines of force through the metal band which forms the rim of the movable wheel generates in it eddy currents. These are continually repelled by the moving field producing them, and hence a motion of rotation is given to the wheel by the alternating magnetism of the magnetic poles.

The speed of rotation, being retarded suitably by the vanes, can be made to be proportional to the current strength of the current exciting the magnets, and hence the total turns of the wheel in a given time to the total electric quantity flowing through the meter.—*London Electrical Engineer.*

The Installations of the Westinghouse Electric Company.

The Westinghouse alternating current apparatus for central station plants has been installed in the following places outside of the United States and Canada: London, Eng., 25,000 lights; Canton, China, 1,500; Halifax, Nova Scotia, 1,400; Havana, Cuba, 4,500; Juiz de Fora, Brazil, S. A., 1,500; Santa Anna, Salvador, C. A., 500; Sansonate, Salvador, C. A., 500; Shidznoka, Japan, 1,500; Vancouver, B. C., 750.

The Westinghouse alternating current incandescent system has now been established in nearly 300 central station plants throughout the country, with a total capacity of almost 600,000 sixteen candle-power lamps. Of these stations, the following have a capacity exceeding 1,000 lamps: Albany, N. Y., 1,300; Allegheny, Pa., 13,000; Allentown, Pa., 1,500; Amherst, Mass., 1,500; Annapolis, Md., 2,250; Aspen, Col., 1,400; Auburn, Me., 2,250; Austin, Tex., 5,200; Baltimore, Md., 5,000; Batavia, N. Y., 1,250; Bath, Me., 1,400; Bay City, Mich., 1,500; Beaver Dam, Wis., 1,300; Binghamton, N. Y., 3,000; Birmingham, Ala., 1,000; Boston, Mass., 3,750; Bristol, Pa., 1,000; Buffalo, N. Y., 3,250; Butte, Mont., 2,250; Carbondale, Pa., 2,050; Cedar Rapids, Iowa, 2,050; Chattanooga, Tenn., 1,960; Clinton, Ill., 1,400; Colorado Springs, Col., 3,450; Columbus, O., 2,600; Conshohocken, Pa., 1,300; Connellsville, Pa., 1,500; Cornwall, Ont., 1,300; Council Bluffs, Iowa, 2,250; Dansville, N. Y., 1,000; Denison, Tex., 1,500; Dennison, O., 1,000; Denver, Col., 16,800; Des Moines, Iowa, 1,000; Du Bois, Pa., 100; Duluth, Minn., 2,800; Eau Claire, Wis., 1,300; Elmira, N. Y., 1,500; Englewood, Ill., 2,250; Flint, Mich., 1,150; Evansville, Ind., 1,300; Fort Worth, Tex., 2,800; Galveston, Tex., 1,300; Greensburg, Pa., 1,350; Hagerstown, Md., 1,300; Halifax, N. S., 1,400; Hamilton, Ont., 2,000; Hartford, Conn., 4,750; Helena, Mont., 1,500; Hoboken, N. J., 1,300; Kansas City, Mo., 3,000; Kansas City, Kans., 1,500; Lincoln, Neb., 1,950; Little Rock, Ark., 2,250; Louisville, Ky., 3,000; Mansfield, O., 1,400; Mauch Chunk, Pa., 1,500; Media, Pa., 1,500; Minneapolis, Minn., 4,500; Moline, Ill., 1,500; Montgomery, Ala., 1,300; Morristown, N. J., 1,300; Nashville, Tenn., 5,500; Newark, N. J., 2,250; New Bedford, Mass., 5,600; Newburgh, N. Y., 1,500; New London, Conn., 1,400; New Orleans, La., 6,500; New York, N. Y., 53,500; Oakland, Cal., 1,300; Ottawa, Ont., 1,500; Oxford, O., 1,000; Parkersburg, W. Va., 1,950; Peekskill, N. Y., 1,300; Philadelphia, Pa., 2,700; Pine Bluff, Ark., 1,300; Pittsfield, Mass., 2,650; Pittsburgh, Pa., 26,450; Pittston, Pa., 1,200; Plainfield, N. J., 3,900; Plattsburg, N. Y., 1,500; Port Jervis, N. Y., 1,400; Portland, Ore., 6,000; Pottsville, Pa., 1,500; Providence, R. I., 7,500; Pueblo, Col., 2,800; Richmond, Va., 6,950; Salem, N. J., 1,000; Salem, O., 2,050; San Francisco, Cal., 1,300; Sandusky, O., 1,300; Saratoga, N. Y., 1,500; Savannah, Ga., 3,350; Schenectady, N. Y., 4,100; Seattle, Wash., 1,500; Sheffield, Ala., 1,300; Sing Sing, N. Y., 1,300; Sioux City, Iowa, 1,400; Skaneateles, N. Y., 1,500; Springfield, Mass., 4,300; Springfield, O., 1,950; Stapleton, N. Y., 5,300; Sterling, Ill., 1,000; Steubenville, O., 2,250; St. Joseph, Mo., 3,750; St. Louis, Mo., 15,000; St. Paul, Minn., 4,100; Tampa, Fla., 1,150; Torrington, Conn., 1,300; Trenton, N. J., 3,900; Troy, N. Y., 1,300; Tyrone, Pa., 1,700; Washington, Pa., 1,250; West Superior, Wis., 1,500; Wheeling, W. Va., 1,950; Wilmerding, Pa., 1,500; Williamsport, Pa., 2,250.

New Electric Railway Work.

The equipment of the Brooklyn and Coney Island Railroad, which is shown in the accompanying illustration, has just been completed by the Thomson-Houston Electric Company, using its well-known system. This road consists of 16 miles of track, which is equipped with center pole double bracket suspension, the trolley wire being suspended from poles placed between the tracks 125 feet apart, and provided with ornamental iron brackets. The construction is done in the most thorough and workmanlike manner, and the general artistic appearance of the line has caused much favorable comment. The car equipment consists of 12 double motor cars, and others will soon be added. The power station is provided with the necessary boilers for supplying steam to three 200 horse-power engines, and the usual heaters, pumps, etc. The electrical apparatus consists of six 100 horse-power Thomson-Houston railway generators of the four-pole type, and switchboard with the usual fittings. A part of the station is used as a car house, and is provided with eight tracks with pits underneath, thus rendering the cleaning and repair work an easy matter.

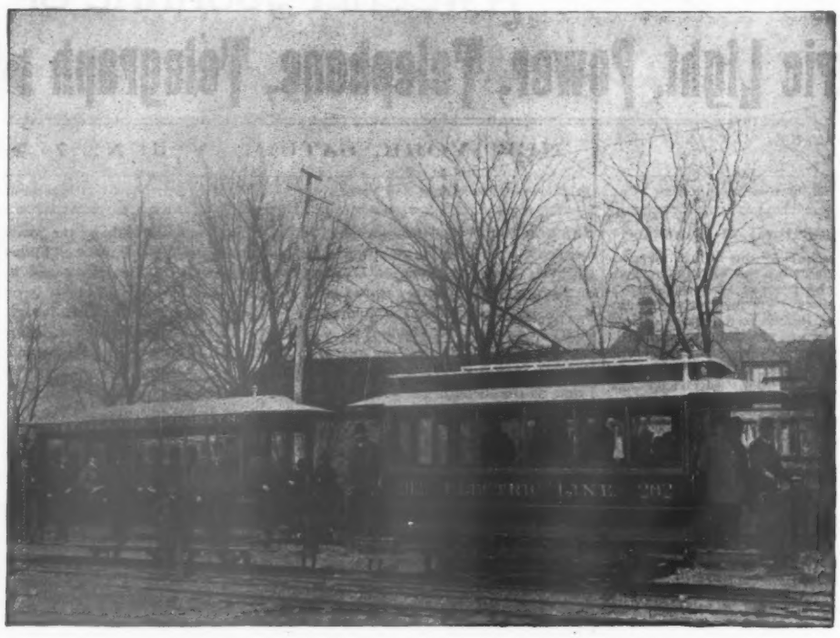


FIG. 1.—THE BROOKLYN AND CONEY ISLAND RAILWAY.

A view of the San Jose and Santa Clara Railway, San Jose, Cal., is also given. This road is interesting, not only from its excellent construction, but that it is the first railway in California equipped by the Thomson-Houston system. The road consists of nine miles of track, on which the double overhead construction has been used, and will operate six double motor cars. The Thomson-Houston Electric Company has recently finished the equipment of the following roads, on which the cars are regularly running:

Georgetown and Tennallytown Street Railway, 6 cars, 6 miles; Vancouver Electric Railway, Vancouver, B. C., 4 cars and 3.50 miles; Utica Belt Line Railway, Utica, N. Y., 25 cars and 20 miles; Milwaukee Cable Company, Milwaukee, Wis., 12 cars and 15 miles; Knoxville Street Railroad, 5 cars and 3.40 miles; North Side Railway, Fort Worth, Tex., 15 cars and 15 miles; Attleborough, North Attleborough & Wrentham Street Railway, 5 cars and 3.50 miles; the Albany Railway, Albany, N. Y., 32 cars and 14 miles.

The power station at Albany is one of the finest which has been built for electric railway purposes. It is a substantial brick building, divided by a brick wall into two rooms, one containing the battery of boilers, and the other engines, generators and electrical appliances. The boilers are ten in number and have a total of 1,350 horse-power. There are six engines of 200 horse-power each. The generators are 12 in number, two being belted direct to each engine, and are capable of producing 80 horse-power each. The boilers, engines and dynamos rest upon brick foundations, which are supported in beds of concrete two feet in thickness, which obviate entirely all tendency to vibration which is usually found in operation of heavy machinery. The plant throughout in every detail is constructed in the most thorough and substantial manner, and this as well as the motor cars have given the utmost satisfaction since the start. The power house was designed by and built under the direction of Mr. L. H. McIntire, the engineer of the Thomson-Houston Railway Engineering Department.

FIG. 2.—VIEW OF THE ELECTRIC RAILWAY AT SAN JOSE, CAL.

——The Edison Electric Illuminating Company has made application to the Board of Public Works, Indianapolis, for a permit to commence work of laying conduits and wires. This means the commencement of work on the Edison electric light plant. Together with the application, the company filed a plan of the work to be done. The conduits will be laid 2 feet from the curbstones, at a depth of 2 feet.

Electric Lighting in Detroit.

When the Brush Electric Light Company lost the contract for the city lighting, says the Detroit *Tribune*, the managers began to look around for some other way to employ their great plant, which seemed likely to be practically idle before long. How well they have succeeded is shown by the following interview with Joseph E. Lockwood, the young and energetic general manager.

"The Brush Electric Light Company," said Mr. Lockwood, "feel that the losing of the public contract was the best thing that ever happened to them, as since we have been sure that it was lost we have been investigating the private demand for electric light and power and have found this field a very large and open one—so much so in fact that for the last 90 days we have been unable to keep up with our orders, but have been at least two weeks behind them all the time. Now we are furnishing far more electricity for private use than we are to the city, and we expect no difficulty in renting, for private purposes, all lights now used for the public lighting.

"We have lately adopted, after careful investigation, the most complete and latest improved system of incandescent lighting invented up to date. Judging from the large number of orders we have received, we are satisfied that the outlook in this field is very promising, and with such advantages as are offered in Eastern cities, we are satisfied that all the better class of residences in this city will soon be illuminated with these lights, and the occupants will be able to enjoy a clean, smokeless, healthy and perfectly safe light without heat or danger of fire, and one that, with improvements now used, will be absolutely safe in the matter of handling.

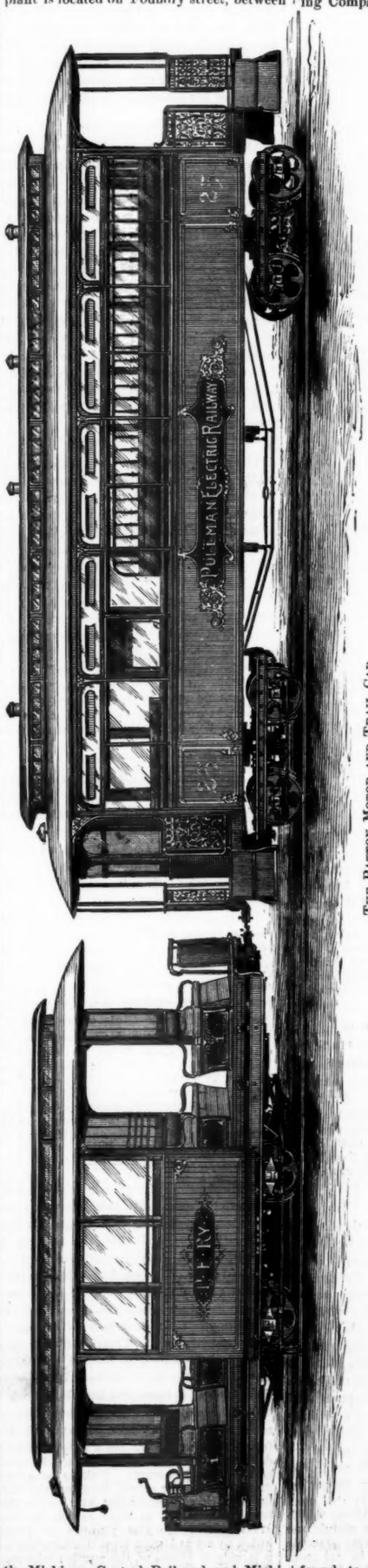
"The system which we have adopted is the one that has lately roused a burst of patriotic feeling in the breasts of the American colony in London, Eng., and which after a severe competitive trial with the best European systems has been adopted and is now being installed in a very large plant. We feel that we have a great advantage over our competitors in the fact that we have been able to secure a system that embodies all the latest improvements, as the changes and inventions of even the last two years have been so great and radical as to work a complete revolution in this field of electric lighting. We are now making a very complete and careful examination of the methods used by the largest and most successful companies in the United States in applying electricity, as we feel that Detroit should have all advantages and improvements known to the science, and we will probably, in from 30 to 60 days, have so completed our investigations as to enable us to furnish to the people of this city electric light of such quality and with such improvements and at such a price as will will be second to no city in the Union.

"We will probably have in operation within 30 days quite a large number of our lights, and we feel satisfied that when they are once seen and compared to other systems that they will not only demonstrate all we've said, but far more. We expect to equip our office with a great many novel and interesting appliances, which we shall be pleased to exhibit to all interested in the wonderful strides made in the past few years in this branch of electrical science.

"In the matter of introducing wires in the stores and residences for our incandescent lights, we would say that we are making a special point, as we feel that this matter cannot be done too well nor can we be too careful about the character and ability of the men entrusted with this important work. With the men and appliances that we have in this department we feel that we can put wires into any building in this city without damaging in the slightest manner any wall, ceiling or furnishing, and without annoying occupants with such a class of workmen as have been generally used for such work. We feel that it is entirely consistent with good work and ability to have quiet, gentlemanly and neat workmen.

"We have secured the agency for some of the very latest improved fixtures for either electricity or both gas and electricity, the designs of which are far beyond anything ever used in this city. In about 30 days, when we begin operating our lights, we shall be pleased to give the public a more detailed description of some of the latest appliances and improvements in incandescent lighting."

The Brush Electric Light Company's plant is located on Foundry street, between the Michigan Central Railroad and Michigan avenue. The machinery for incandescent lighting has arrived and is now being put in position.



THE PATTON MOTOR AND TRAIL CAR.

The Patton Motor.

The illustration shows a Patton motor car attached to a Pullman double truck palace street car. This is the first electric motor car made by the Patton Motor Manufacturing Company, of Chicago, upon a system distinctively their own. The basis of operation is the generation of electricity upon the vehicle, thus rendering each car independent, and dispensing with overhead or conduit wires for the transmission of electric force. By this system also all the obstacles which have rendered the service of many storage battery cars so unsatisfactory have been removed.

The gas engine runs continuously, and is geared to a dynamo generating electricity, which is received by accumulators, where it is stored for service as desired. An electric motor is geared to the axles, and the current necessary for the propulsion is admitted to the said motor in a greater or less degree, according to the power required at any given moment. Thus the movement of the car is entirely subject to the will of the operator, who can regulate the propelling force in accordance with the obstacles to be overcome. Meantime the storage batteries are kept continually charged by the engine and dynamo, so that reserve force is always in readiness for any emergency. The entire cost of maintenance of this power is $1\frac{1}{10}$ cents per mile. The engine, dynamo and motor are carried upon a truck specially devised for the purpose, by which plan the car body can be removed very readily, and the same truck suffice for an open car in summer or closed car in winter. The batteries are arranged under the seats of the car. The motor car, as shown in the accompanying cut, weighs, with the truck and all mechanism complete, 14,100 pounds, and has seating capacity for 30 passengers.

Electric Lighting in Seattle, Wash.

The present lighting of Seattle is done by the Seattle Electric Light Company, which has recently passed under the management of Henry Villard, as part of a large scheme of operations, says the *Intelligencer*, of that city. There are three other companies doing business here, the Pacific Electric Light Company, the Commercial Electric and the Seattle Gas and Electric. It would seem, therefore, that there is sufficient competition to insure a reasonable cost to the city, and the only open question is that of duration of contract, as the longer period over which the cost of construction is spread, the less the proportion to each light.

At present the city has 24 arc lights at a cost of $14 per month each, 395 incandescent lights of 15 candle-power at $2.25 per month, and 95 of 30 candle-power at $3.50 per month, each. The incandescent lights are becoming more generally used in the residence portions of cities, and, at from 20 to 30 candle-power, are found to answer all requirements. The incandescent lights range in price from $1.50 in some cities to $3.00 for 25 candle-power, that most generally used.

Keokuk, Ia.—The Keokuk Hydraulic and Electric Company; to utilize the power of the Des Moines Rapids and the Mississippi River. Capital, $500.000.

Little Rock, Ark.—Heber & Searcy Valley Telephone Company; capital, $5,000. The officers are: J. E. Lightle, president, and J. R. B. Moore, vice-president.

Creston, Ia.—The Creston Electric Light Company. Capital, $60,000. Directors, B. F. Helnly, Walter Cullen, W. R. Vaughan, J. C. Regan and W. R. Vaughan, Jr.

Chicago, Ill.—Fort Dearborn Light and Power Company, to buy and operate electric machinery, etc.; capital stock, $25,000; incorporators, A. L. Baker, E. F. Runyon and S. T. Parks.

Atlantic, Ia.—The Harding Electrical Conduit Company. Capital, $600,000. The officers of the company are: C. K. Harding, president, and W. H. Applegate, secretary and treasurer.

Portland, Ore.—The Springfield Investment and Power Company; principal place of business, Portland; capital stock, $500,000. B. J. Pengra, C. B. Bellinger, C. E. Lockwood, incorporators.

Detroit, Mich.—The United States Electric Company has been incorporated to handle electrical devices in Michigan and Ohio on a capital of $50,000. The stockholders are William E. Irish, of Brooklyn Village, Ohio; Robert S. West, John C. Hutchins and Thomas D. Owen, of Cleveland, and H. P. Davock and A. W. Beal, of Detroit.

Syracuse, N. Y.—The Syracuse Consolidated Street Railway Company. The length of the line is 40 miles, and the capital $1,250,000, divided into $100 shares. The directors include Simon Wormser, Casimir Tag, Lathrop R. Bacon, New York; Clarence H. Wildes, Riverdale; John Dunn, Jr., Louis Marshall, Manning Palmer and Hamilton S. White, of Syracuse.

Taunton, Mass.—At the annual meeting of the Taunton Electric Lighting Company, May 26th, P. H. Corr was chosen president; Nomus Page, treasurer; Mortimer Westcoat, corporation clerk; directors, A. G. Williams, P. H. Corr, N. Paige, G. W. Colby. A dividend of seven per cent. was declared. It was voted to increase the capital stock to $50,000, to build at once a two-story brick building, 50x50, to put in three new engines of 200, 90 and 75 horse-power, respectively, the last for supplying motive power, and to change the system of incandescent light to the alternating. Other improvements are under consideration.

Another Power Station for the West End Road.

The new central power station of the West End Street Railway Company, of Boston, will consist of a power house and boiler room. The former will be 319x173 feet, built of brick and granite. In this building will be 13 triple expansion engines of 1,000 horse-power each, and a 300 horse-power compound engine for use in the early morning hours when the number of cars upon the tracks is limited. The boiler house will be 163x84 feet, and it will contain 24 boilers, rated at 500 horse-power each and set in batteries of two boilers each. The massive foundations for the large engines and the chimney are well under way, and it is expected to have the station complete by next Fall. Six of the 100 horse-power engines will be put in as soon as the station is ready for their reception, and one-half of the boilers will be placed at once.

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The electric light at the Metropolitan Museum is a great success, and is so pronounced both by the trustees and the public. The Museum is now open two nights a week, and, although the innovation is of very recent date, the attendance is very large and on a rapidly increasing scale. It is expected that when the weather becomes warmer the Museum will be crowded in the evenings.

A bright little weekly which is meeting with the great success it deserves is *Chatter*, published in this city. The paper is conducted by Julian Ralph, whose name is familiar to all magazine readers. Mr. Ralph is a newspaper man and journalist of experience. *Chatter* occupies a unique place; in fact, it has created a place for itself among the many weeklies published in New York. Each succeeding issue is better than the last, and the artistic illustrations are a feature of great merit.

The organizing committee of the International Electrical Exhibition, to be held at Frankfort in 1891, has just passed a very wise resolution. A member of the committee pointed out that the firms taking part in an electrical exhibition incurred very heavy expenses, and that it would be only fair that they should receive a certain proportion of the profits in recognition of their share in contributing to the success of the exhibition and as recompense for the expense and trouble to which they are put. These views were favorably received, and, after a short discussion, it was resolved that one-half of the net profits should be set aside to be distributed among the exhibitors in proportion to their respective expenses. If the managers of other electrical exhibitions which may be organized in the future should see fit to adopt this liberal and very sensible policy, such undertakings will be far more popular with exhibiting firms than has been the case heretofore.

The question of perfect insulation is one of the most important problems with which the electrical engineer has to deal. It is claimed that a covering of cotton and spun glass jacketed with woven cotton dipped in paraffine has been invented, and is said to be perfectly effective and practically indestructible. Provided the cost of manufacture is reasonable, it would seem as if this were the *ne plus ultra* of insulating materials. If the inventor can do what he claims and maintain control of his patents, he need not speculate in Wall street.

Almost every day the REVIEW is in receipt of requests for sample copies, information, etc., from people who sign their names without giving any address. Now, for all we know, "Yours respectfully, Alphabet Smythe," may be the mayor of Smytheville and a prominent man. But when he sends us a whole postal card carrying his request, and simply signs it "Alphabet Smythe," with no heading or town, county or State named, we are puzzled. We are philanthropists, and only exist and publish this journal for the good of our fellow-men; but we are too poor to establish a "Bureau for Mind-Reading at a Distance," and a "Department for Deciphering Crippled Chirography."

Theatrical managers are beginning to realize the advantages of certain applications of electricity. The lighting of auditorium and stage by the incandescent system is not so new as the introduction of the electric fan and blower for chilling and changing the air. The arc light is used in many theatres to illuminate the stage during the day. Electric motors are used to operate the drop curtain and to move a revolving stage. Incandescent lighting on the stage is easier and safer of operation than gas. "Floats," "border lights," "clusters," and colored lights are all possible and beautiful when operated by electricity. The whistling of the wind through the rigging of a ship and the flag floating in the breeze, are accomplished by the electric motor.

A short time ago we drew attention to the fact that a French contemporary, in defiance of the republican simplicity of style affected by distinguished American scientists, had referred to Prof. Le Conte Stevens as *le comte* Stevens. In the last issue of *La Lumière Electrique*, just to hand, we find the following paragraph:

"Our Parisian confreres often fall into certain errors, which, when noticed across the Channel or on the other side of the Atlantic, cause no small amount of amusement. It appears that one of them, in relating the proceedings at a meeting of the New York Electric Club, where Professor Cross recently lectured on acoustics, had occasion to mention the name of Prof. Le Conte Stevens, of Brooklyn; this gentleman became by a stroke of the Parisian chronicler's pen, Count Stevens, of Brooklyn."

The best of the joke, however, is that the like error occurred in the columns of the self-same *Lumière Electrique*, although we did not mention it at the time.

Medical authorities who have studied the dangers to human life from electrical currents, are agreed that this danger has been over-estimated, and that the number of fatalities is not as large as represented. A medical journal has concluded that electrical currents produce three kinds of severe accidents. Instantaneous death, or severe burns, or traumatic neurosis caused by the mental and physical shock. Usually, if the person receiving the shock is burned, he is not killed. Practically, if contact with the wires does not kill, a burn or a harmless shock is the only result. Paralysis of the nerves or nerve centers is very rare. During the last ten years there have been only about 100 deaths in the whole world caused by artificial electrical currents. Taking as a basis of comparison the capital invested, the number of serious injuries met with in the electrical field is not as large as that in other great industries. The number of people killed by asphyxiation from illuminating gas is largely in excess of the number who meet death by coming in contact with heavily charged electrical conductors.

WANTED, A TELEGRAPH LINE.

In the May issue of the *India Rubber World*, published in this city, we find an interesting article on the rubber trade of Brazil. It appears that Manaos, the capital of the province of Amazonas, is the center of the most important rubber district in Brazil, and has a rapidly increasing export trade, whereas that of Para, its principal rival in the rubber business, is steadily decreasing. The river Amazon is navigable up to Manaos for vessels drawing as much as 24 feet, and already two lines of ocean-going steamships visit the port at regular intervals, taking mixed cargoes of manufactured goods and bringing away rubber. There is one great obstacle to the development of trade between Manaos (which is described as a very thriving city) and the United States, and that is the absence of telegraphic communication. Para, being the more powerful province, refuses to permit the laying of a cable, but in any case, we should think, no one would propose to lay a cable 600 miles along a river. What is required, as the article points out, is a line from Manaos to Georgetown, British Guiana, a distance of about 600 miles. For the greater part of the distance the rivers Negro and Branco could be followed, and at Georgetown connection could be made with the West Indian system of cables, thus securing direct communication with the United States. That such a line would be comparatively easy to construct there seems to be no doubt, and the enterprising concessionaire would get very handsome returns; the only difficulty we see in the way is that of getting a concession to build and maintain the line, and given the rivalry between Para and Manaos and the present unsettled state of affairs in Brazil, the difficulty seems to be rather a serious one. The Brazilian government, too, is not famous for good faith and strict uprightness in the matter of telegraph concessions.

It is said that the dome of St. Peter's, Rome, is cracking in a somewhat serious manner. It appears that about 100 years ago similar defects were discovered, and the remedy applied was to encircle the dome with a strong band of metal; the band was heated, and its contraction on cooling was found to be sufficient to close up the cracks. An electrical paper suggests a similar method of remedying the present defects, electricity to be employed for heating the band. We imagine that the dome itself would scarcely hold the dynamo that would be necessary to generate sufficient current to heat a metal band of the required dimensions.

William Black, the novelist, says that years ago he came upon a striking passage in a novel by James Payne, in which the heroine was described as being buffeted about by a terrible gale, inasmuch that her raven-black hair streamed out to *windward*. Black wrote to Payne suggesting that there was something wrong, as things capable of streaming out in a gale generally went, not to windward, but to leeward. The reply was that the description was perfectly correct, the heroine had been taking a great deal of iron tonic, her hair had become electrically charged and had floated out toward the north, irrespective of the wind currents of the storm. There is animal magnetism with a vengeance!

The *Telegrafista Español* protests against the extravagant representation of the Spanish Telegraph Department at the Paris Telegraph Conference. Although the department sent none of its members to study the electrical display at the exhibition last year, no less a sum than $3,600 has been voted to defray the expenses of the commission representing Spain at the telegraph conference. There are three delegates, one being the director-general, another the chief of the international division, and the third the chief of the office devoted solely to keeping records of particulars relating to the employés, their location, leaves of absence, etc. The *Telegrafista* very naturally wonders what mission this last official can possibly have to fulfil at the conference.

CORRESPONDENCE.

Electrical Happenings in Chicago, Boston, Philadelphia and Washington.

OUR PHILADELPHIA LETTER.

Tatham & Brothers, 220 South Fifth street, note an ever-increasing demand for their lead covered cables. A special feature of great importance in the manufacture of this brand of cables is that no oil or pinholes are ever found in the lead casing. A joint is hardly perceptible, being exactly the same size as the other parts and perfectly smooth. Mr. Engel, formerly of the Hibbard Company, of Montreal, is the electrician for Tatham & Brothers.

Partrick & Carter, 114 South Second street, are very busy getting out a new annunciator, patents for which have recently been issued. This firm has enjoyed a very prosperous year in their general supply business, and present indications point to a steady continuance of the same.

Mr. H. T. Paiste, of Twelfth and Market streets, has started on a four months' European trip. Mr. Jenkins will officiate during Mr. Paiste's absence.

Chadbourne, Hazelton & Co., whose handsome offices are in the Commercial Union Building on Walnut street, will soon have in operation an exhibition Wenstrom plant. The demand for these dynamos and motors is rapidly increasing and the plants already established are giving the best of satisfaction. Mr. Hazelton has been very busy lately establishing agencies for the sale of the Wenstrom apparatus.

Mr. Chas. A. Bragg, of the Westinghouse Company, states that everything electrical in this city is enjoying a steady growth. The electric lighting interest is on a special boom, and Westinghouse apparatus is in constant demand. Mr. George F. Porter, Mr. Bragg's associate, has just returned from a long western trip. Both of these energetic gentlemen find their time fully occupied in stirring up the gentle Quaker to a due appreciation of electrical things in general and the Westinghouse apparatus in particular.

The Thackara Manufacturing Company, 1524 Chestnut street, have a large and growing trade which keeps their large office force constantly busy. About 350 hands are kept employed in their factory the year round. Mr. Sawyer expects to leave very soon for a six weeks' trip to California, in search of quiet and rest. Mr. Sawyer deserves a well earned vacation.

In the Northern Part of the city, on Lehigh avenue, an experimental storage battery line is in operation. Two cars fitted with the McLaughlin batteries make regular trips. This is the only electric railway in the city.

S. L. C.

Philadelphia, Pa., May 31, 1890.

OUR WASHINGTON LETTER.

Capt. Wm. T. Rosell, of the District of Columbia, is making an investigation of numerous police patrol systems, erected in various cities by the Gamewell Company and the Municipal Signal Company, for the purpose of ascertaining which of these two systems is best adapted to the needs of the Washington department, in the Georgetown precinct. Proposals from both companies are under consideration.

Alfred E. Raddell, the Electric Inspector of the Underwriters' Association of the Middle Department, which embraces the States of Pennsylvania, Delaware, Maryland and the District of Columbia, has reached Washington on his tour of duty. He finds but little difficulty in convincing owners of isolated plants in buildings wired with paraffine insulated wire that the safety of their premises can be increased by some slight changes.

Engineer Mailloux is still at work on the storage battery car experiments of the Metropolitan Street Railway, in Washington. He is making some modifications in the gearing, and is preparing to test the McLaughlin accumulators.

The Electric Lighting Company of Washington, is preparing to extend its arc and incandescent lighting service out to Fourteenth street, a distance of one mile, in terra cotta conduits which are being laid by the Washington Terra Cotta Conduit Company.

Washington, May 31. G. C. M.

OUR BOSTON LETTER.

The Russell Electric Lamp Company, of this city, has issued a neat pamphlet setting forth the merits and peculiar fitness of the new Russell arc lamp.

North Shore Electric Light Company, Beachmont, Mass., has secured a contract to furnish the town of Revere with arc and incandescent lights.

Rutland, Vt., Electric Light Company has been awarded a three years' contract to furnish power for the machinery of the new works of the Howe Scale Company.

Electric Light Competition.—There are two electric light companies in Rutland, Vt., and the demand for electric illuminants has been so great that both companies are increasing the lighting capacity of their respective stations.

The Connecticut Motor Company has established an agency in New York with Messrs. Zimdars & Hunt in charge. The agency is at No. 127 Fifth avenue, where one of the Connecticut electric motors may be seen in operation. Secretary J. R. Stagg reports the business of his company as active and steadily increasing.

Messrs. Nightingale & Childs, of this city, report an increasing demand for their Magnesia boiler and pipe covering from electric light companies. The perfect non-conducting nature of the covering, which ensures increased economy in the use of steam, is being rapidly appreciated, hence the popular demand for it.

Another Electric Railway Enterprise.—The project of building an electric road between Whitman and Abington, Mass., to run to Rockland and connect with the Weymouth line, is under consideration. In case this comes about, Brockton will have direct electric road connection with all these towns when the Whitman line is completed.

Messrs. McKenney and Waterbury are proprietors of the Boston headquarters for combination (electric and gas) fixtures, electroliers and ornamental lamps, at the corner of Franklin and Congress streets. This enterprising and wide-awake young firm has, in less than two years, built up a large and rapidly increasing business, and to day its establishment is one of the most completely stocked and best patronized fixture marts in New England.

New Electric Railway at Worcester, Mass.—The work on the new electric railway line on Grafton street began this morning, under the management of Messrs. T. W. Harris & Company, of Boston. The men, 24 in number, began the work at Elm square, and are working down the hill in charge of Foreman J. J. McCullough. The rails have arrived, and will be laid as soon as possible. The single trolley wire system of the Thomson-Houston Electric Company will be used.

New Electric Light Station at North Adams.—The new electric light station of the North Adams Gas Company is practically completed, and the setting up of machinery will begin at once. The plant consists of a dynamo and engine room 26 by 54 feet and boiler house 32 by 20 feet, 30 feet high. The electric light machinery will be three 50-light arc dynamos and one incandescent of 50-light power. The buildings all arranged so as to increase and enlarge the plant whenever necessary. The Wright Electrical Engineering Company has been awarded the contract for the wiring and construction work.

The Inter-Continental Telephone Company has received £25,000 through Messrs. Kidder, Peabody & Company, amount due the company by an English syndicate. This large sum will soon be distributed among the company's shareholders, and it is said that the Tropical American Telephone Company will get the "Lion's Share."

The Taunton Electric Light Company held its annual meeting recently and elected the following officers: P. H. Carr, president; Nomus Page, treasurer; Mortimer Westcoat, corporation clerk; directors, A. G. Williams, P. H. Corr, N. Paige, G. W. Colby. A dividend of seven per cent. was declared. The company also voted to increase capital stock from $30,000 to $50,000, and additional land has been bought on which a new two-story building will be erected, 50x50 feet. When in running order the plant will be three or four times the capacity of the old one. The alternating system of incandescent lighting will be adopted, and the necessary apparatus has been ordered. A power circuit is to be started for manufacturers.

The Electric Mutual Insurance Company, of Boston, in entering upon so grand a work it has mapped out, has the sympathy, good will and hearty support of the electrical interests of New England. In good time most of—if not all—the electric light companies of other sections of the country will fall into line and follow the example of their Eastern friends, inasmuch as it is the aim of the Electric Mutual to reduce the heretofore exorbitant insurance rates on electric light stations—the old tariff to be ignored—and all stations rated hereafter on their respective merits alone.

Electric Stocks.—Boston quotations at closing hour of the Exchange, Saturday, May 31, were as follows:

Thomson-Houston Electric Company	65⅛
" " " " Preferred.	26¾.
" " " " Series C..	17.
" " " " Series D .	8¼.
Thomson Electric Welding Co	225.
" European Welding Co	112.
Westinghouse Electric Co	41.
Fort Wayne Electric Co	14.
Lynn Gas and Electric Co	150.
Edison Phonograph Doll Co	3⅛.
TELEPHONE:	
American Bell	226.
Erie	43¼.
New England	52.
Mexican	1.50
Tropical American	1.37½
National Tel. Mfg. Co. (acoustic)	.65

Boston, May 31, 1890. W. I. B.

OUR CHICAGO LETTER.

The Thomson-Houston Electric Company report the following sales: Hammond Milling Company, Hammond, Ind., 50 incandescent direct; Kalamazoo Electric Company, Kalamazoo, Mich., 650 alternating and 50 arc; Gratwick, Smith and Fryer Lumber Company, Osceola, Mich., 350 incandescent direct; J. P. Anderson, Trenton, Mo., 30 arc and 650 alternating incandescent; Joliet Wheel Company, Joliet, Ill., 5 arc; Moffet, Hodgkins & Clark, La Grange, Ill., 650 alternating incandescent; Battle Creek Electric Company, Battle Creek, Mich., 35 arc; Salt Lake Power, Light and Heating Company, Salt Lake City, Utah, 30 arc and four 650 light alternating incandescent dynamos; G. F. & E. A. Burkhart, 196 West Twelfth street, Chicago, 35 incandescent direct; C. Hebbard & Son, Pequaming, Mich., 150 lights, motor type dynamo; Marysville Electric Light and Power Company, Marysville, Cal., 650 alternating incandescent; Swanton & Clark, Santa Cruz, Cal., 650 alternating incandescent; D. C. Metsker, Sedalia, Mo., 650 alternating incandescent.

Personal.—C. G. Armstrong, who has for some time been in charge of the house goods department of G. A. Harmount & Company, has resigned and will accept a like position with the Great Western Electrical Supply Company.—Ernest L. Clark, secretary of the Illinois Electric Material Company, left Thursday night on a flying trip East.—Thomas F. Bechtel, secretary of the Edison Electric Light Company, Grand Rapids, Mich., was a recent visitor in the city.

The Central Electric Company have sold an entire Candee wire equipment for an electric railway system. D. B. D.

May 31, 1890.

Queer Charges.

Recent press despatches from the West state that on the night of February 4th the Western Union telegraph wires were cut two miles East of Jamestown, N. D., and that investigation proves that the work was done by a prominent Nothern Pacific official and two operators, and it is supposed at the instance of a still higher official, who, it is said, worked the wire himself in Bismarck. At that time a great many telegrams, both for and against the lottery project, were passing over the wires and the operators side-tracked such as were unfavorable to the lottery, and rushed the others through with all possible haste. It is charged that they advised the friends of the lottery of the contents of messages intended for the anti-lottery people in advance of their delivery to those entitled to them, and thus put the lottery crowd in possession of the secrets and plans of the anti-lottery people, before the opponents of the lottery could communicate with each other in different parts of the State. Long petitions and lists of names in favor of the lottery were, it is said, rushed through without charge, while protests against the lottery were delayed. Passes were issued indiscriminately to friends of the lottery bill, written on ordinary note heads, with orders to conductors that they be returned to the prominent official when taken up. The Western Union has made careful investigation of the charges, and is said to have obtained satisfactory proof of their truth.

GENERAL NOTES.

The Cincinnati fire alarm uses 600 miles of wire, 700 batteries and 350 alarm boxes.

It must weaken Kemmler's constitution to know that electrical execution is constitutional.—*N. Y. Press.*

Laconia, N. H., has recently shown her enterprise in the organization of an electric light company, which has since awarded the contract to the Westinghouse Electric Company for the furnishing of alternating current apparatus of 1,250 lights capacity.

The Thomson-Houston Company shows this summary of gross sales and profits, also the ord ersfor electric motors and generators for the three months to April 30, 1890, compared with 1889, it being the first quarter of the fiscal year:

	1890.	1889.	Increase.
Gross sales	$2,133,099	$1,139,883	$993,266
Profits	650,724	299,613	351,111
Motors ordered	1,106	247	859
Generators ordered	112	16	96

Two telegraph operators were arrested at the Athletic base ball grounds in Philadelphia last week. The secretary of the base ball association testified that the defendants were employed by the Western Union Telegraph Company, and that they had been in the habit of throwing written reports of the games over the fence to messengers in waiting, who took them to the nearest telegraph station. The Postal Telegraph Company had paid $250, he stated, for the exclusive right of having telegraphic instruments on the grounds. The prisoners were held for a further hearing.

PERSONAL.

Mr. J. I. Sabin, of San Francisco, is visiting friends in the East, accompanied by his wife.

Capt. E. L. Zalinski, U. S. A., returned to New York last week after a year's absence in Europe.

Mr. Eugene F. Phillips came over from Providence to spend Decoration Day in the city accompanied by his family.

Mr. H. P. Lucas, of the Northwest Electrical Supply and Construction Company, St. Paul, is stopping at an up-town hotel for a few days.

"Ned" Fox, the ubiquitous traveling agent of the Phœnix Glass Company, is in town. "Ned" has an alleged reason why Kemmler should not be executed electrically. He says it would be a revolting proceeding.

Mr. Herbert H. Eustis, president and electrician of the Eastern Electric Cable Company, Boston, was a New York visitor last week, coming over to meet his family on their return from a five years' visit in Europe.

The Yellow Cover.

Our bright little contemporary, *Chatter*, makes the following statement in its issue of May 7th: "When *Chatter* was born it was the only yellow periodical in America, except *Ayer's Almanac.*" We don't know when the almanac donned the yellow dress, but we do know that more than two years before *Chatter* was born, the ELECTRICAL REVIEW adopted its present yellow cover. We agree with Editor Ralph when he says: "But we cannot take all the credit of a discoverer for thus restoring the loveliest of colors to its proper rank, because Nature got ahead of us when she produced the dandelion and the sunflower."

BOOK NOTICES.

The May issue of Whipple's Electric Reports gives the following information: Number of central electric light stations in operation in the United States, 1,515; Canada, 92; Mexico, 9; Cuba, 2; total, 1,618. Electric railways in operation and under contract in the United States, 224; Canada, 4; total, 228.

We have received "Brown's Directory of American Gas Companies," for 1890. This is the third annual volume of this work, which has now become the recognized authority on the subjects of which it treats. The total number of gas companies is 1,048; of these 304 operate electric light plants of their own, furnishing current for 31,558 arc lamps, and 132,771 incandescent lamps.

Telephones in Demand.

The American Bell Telephone Company reports a net increase in instruments of 469 for the month ended May 20, and an increase of 1,124 for five months. The comparative figures follow:

Month May 20.	1890.	1889.	Inc.
Gross output	6,938	5,902	1,036
Returned	2,135	1,568	567
Net output	4,803	4,334	469
Since Dec. 20.	1889-'90.	1888-'89.	
Gross output	25,819	23,705	2,114
Returned	10,177	9,187	990
Net output	15,642	14,518	1,124

Total instruments in use May 20, 1890, 460,503.

A Heavily Loaded Washington Elevator.

Seven well-known electrical men, namely, Messrs. H. D. Stanley, Cyrus O. Baker, Jr., Clarence E. Stump, Fred W. Royce, P. H. Alexander, C. H. Barney and Frank C. Mason, had an experience in Washington last week that they will never forget, and which will explain the many grey hairs added to each head.

Descending from their rooms, on the ninth floor of the Willard Hotel, the elevator broke and all seven were suddenly precipitated down several floors, the elevator rebounding after striking the air cushions and stopping between two floors, where it is still said to be tightly wedged.

The elevator boy was the only one hurt, his hands being severely bruised, but all were badly shaken up and their peace of mind much disturbed. It looked at one time as if they would have to remain and be fed through a crack, but they finally managed to crawl out of the elevator covered with plaster and things.

Telephonic News

*** The Cleveland Division of the Erie Telephone made a net gain of 35 subscribers in April.

*** The Southern Company will begin putting cables in its newly laid underground conduits at Hartford, Conn., next week.

*** The Missouri & Kansas Telephone Company paid a dividend of 1¼ per cent., May 15, of the first quarter's earnings for 1890.

*** Uncle Sam is building a telephone line connecting the life-saving stations along the coast of Cape Cod. A similar line should be put up for the benefit of the New Hampshire stations.—*Portsmouth Times.*

*** It is stated that the telephone company in Milwaukee will bring suit against the electric street railway company. It is claimed that the telephone system, in some parts of the city, has been rendered almost useless since the railway started.

*** It is understood that the Providence Telephone Company will stop work upon the reconstruction of its lines at Newport, R. I., over which so much opposition has been developed, and will seek compensation from the city for damages already suffered through lack of police protection.

Unit of Self-Induction.

The New York ELECTRICAL REVIEW says, with reference to the unit of self-induction: Call it "Henry." If every American electrician accepts, foreign electricians will join them and the conference of 1892 will ratify the choice.—*London Electrical Engineer.*

The Brooks Insulation.

TO THE EDITOR OF ELECTRICAL REVIEW:

On Saturday, May 24th, your correspondent visited an electric light installation by the United Electric Improvement Company, at their works in Gloucester, N. J.; also witnessed some interesting tests of the insulation of the underground main conductor, which is a No. 0 gauge drawn into a wrought iron pipe buried some two feet below the surface of the ground, and insulated by the Brooks system, carrying a current of 2,700 volts and nine amperes feeding the current to 50 arc lamps. The insulation tests by the ordinary galvanometer method showed something over 1,000 megohms per mile, but a more satisfactory test was by a Holtz machine, which produced a spark six inches in length. This failed to puncture the insulation or effect it in any way. I believe this method of proving the insulation of electric light mains was first practiced by Menier, of Paris.

It is now pretty well known that an insulation which may test very high galvanometrically with the potential of 200 to 500 elements, may, when subjected to the pressure of 2,000 or more volts, be broken down or disrupted.

William Maver, Jr., in an article published March 1st in an electrical journal, states that a cable measuring 20,000 megohms per mile of insulation in the factory, broke down by a dynamo current of 600 volts after being drawn into a conduit.

Warren de la Rue and Hugo Muller published the following table as the striking distance between a point and a disk. It is given as a matter of reference for those interested:

Inches.	E. M. F. in Volts.
0.5	11,700
1	23,400
2	46,700
3	70,100
4	93,500
5	116,800
6	140,200
7	163,600
8	186,900
9	210,300
10	233,700
20	467,300
30	701,000
40	734,700
50	1,168,300

It is stated that these experimenters used a battery of 11,000 cells as a basis for forming the foregoing table. Not long since there appeared a statement in the electrical journals that the Ferranti concentric main that was to supply a goodly portion of London with artificial light stood an insulation test of a million of volts. It was supposed this statement was authorized by Ferranti himself, and thereby gained widespread circulation; but on its face it was about as absurd as would have been a statement of the exact distance in inches to one of the fixed stars.

Up to this date I cannot learn than Ferranti has succeeded in making his cable work, though some showing in laboratory tests have been made—if I remember right, a showing of a 20,000 volt test. This is a statement of his own.

This Gloucester cable is insulated with a semi-liquid preparation which is comparatively cheap, and an increase of insulation does not proportionately increase the cost per conductor.

There is another feature of this method of insulation. The pipes are laid in the ground and the conductors drawn in and insulated afterwards. In this respect it differs from all other modes. Cables insulated in factories and afterwards coiled, uncoiled and drawn into conduits, are liable to injury by that operation, especially so if employed for arc lighting purposes. There were at Gloucester a variety of specimens of arc lighting cable, the insulation of which was easily punctured by a spark of less than one inch in length. Many authorities quote dry air as the highest insulating medium, and it is probably correct, as tested by ordinary methods; but for high voltages it certainly does not compare with liquids. Bearing upon this point was a statement by Mr. Foudersmith, electrician of the Pennsylvania Railroad Company, who was present and witnessed these experiments. His statement was that of the 53 conductors laid by Mr. Brooks three years since on the Pennsylvania Railroad; not one of them had ever been interrupted by atmospheric discharges or any other cause, though lightning was a great source of trouble and interruption to all other kinds of insulation used for underground and river crossings, and that the insulation of this Brooks cable, one and one-third miles in length, was at this day thousands of megohms per mile, and as high, or higher, than when first laid. C. M.

Philadelphia, May 31.

Morgan's Automatic Electric Signaling System.

Morgan's automatic electric signaling system is designed primarily for communicating between policemen on the beat and the inspector in the district station. To effect this end there are placed in the district a number of call stations each of which consists of a lamp post with a locked box containing the signaling mechanism, and each lamp post is connected by a separate and independent wire with the police station. When the inspector desires to communicate an order to a particular policeman he connects the wire leading to the lamp in that man's beat to the central instrument, and he turns an index, working over a dial, on which are printed various orders and questions, until it points to the particular order which he desires to give. Immediately he does this the gas in the lamp is lighted, and a red glass is made to encircle the flame to call the policeman's attention. As soon as the man sees this he proceeds to the post, opens the box, and inside finds a pointer marking the order or question which is to be laid before him. If a reply is needed he puts the pointer of a second dial to the reply, and immediately the pointer in the central station takes up a corresponding position; or he may send the word "telephone," and then converse with his officer through the telephone which forms part of the equipment of his box.

If it is the policeman who requires to make his wants known, the process is equally simple. He opens the box and turns his pointer to the message he wants to convey, such as "Burglary being committed," "Send ambulance," "Riot threatening," or the like. Immediately a gong is sounded in the central office, a pointer shows the number of the box from which the message comes, and a second pointer indicates the message. Further remarks can then be exchanged, or the pointer may be merely returned to zero, which shows that the message has been received and understood.

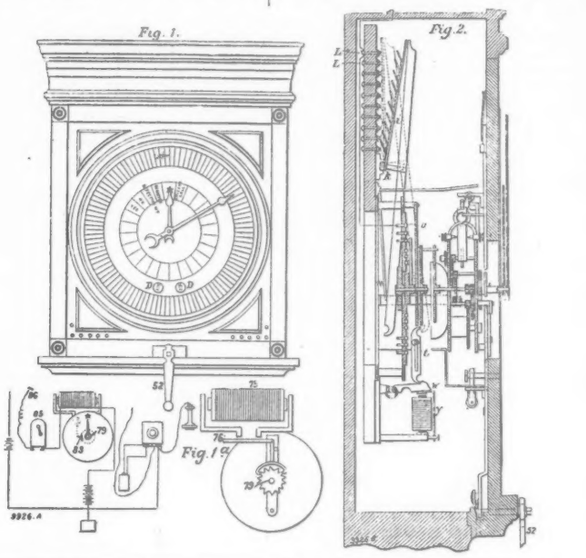
In order to secure vigilance on the part of a policeman he may be ordered to report himself from lamp posts at different parts of his beat at frequent intervals. This is done by his first sending the word "Report,' followed by a Morse signal of dots and dashes, or dashes only. This latter signal is sent automatically by means of a little clockwork instrument which each man carries in his pocket which, when wound up, can be made to rotate a commutator so as to work a Morse recorder in the central station in a way which gives a certain conventional set of signals. By this device the inspector is assured of the presence of the policeman himself at the lamp post.

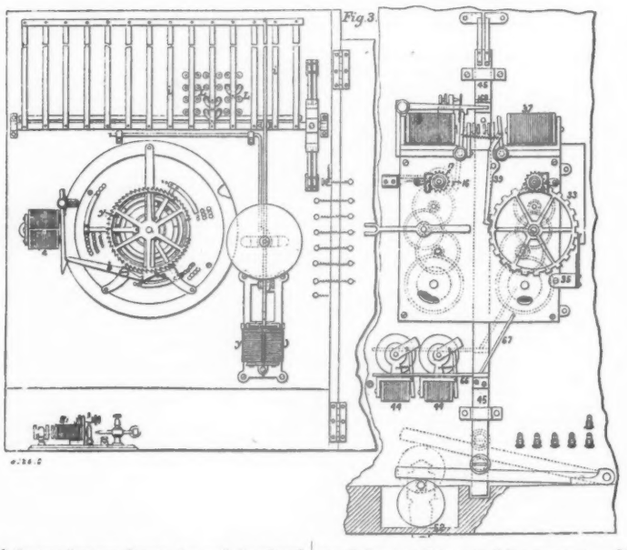
From this cursory description it will be seen that the inventor has produced a system which needs no acquired or technical skill in the working. Anybody can manipulate it after two minutes' instruction, and it does not suffer from induction as it would if it were merely a telephone system. No one can doubt that it would greatly increase the usefulness of the police if they could be kept in touch with the station at all times, and if the inspector could communicate with them with a very short delay; of course, the system is applicable to other purposes than sending messages to and from policemen. Instruments for the dispatch of messages only can be placed in houses, shops and public institutions, while, with a little modification, the bedrooms and corridors of an hotel might be connected to the porter's lodge or the bar.

The mechanical and electrical appliances used in the transmission of the signals are illustrated on the present and opposite pages, but before referring in detail to them we will give a general idea of their construction. The wires entering a police station, say one hundred, end in a switchboard, on which is a terminal knob for each wire; each knob is in contact with a spring carried on a pivoted frame. Each wire is also connected to another terminal knob, of which there are one hundred arranged in a circle. When a lamp box is opened and the sending index is set, the wire leading to the box is put to earth, and a current flows through it from a battery in the central station. This current energizes an electro-magnet which trips a catch, releasing the pivoted frame with its springs from contact with the switchboard, and setting into action a train of clockwork.

The tripping of the catch breaks the circuit, while the clockwork moves a feeler around the circle of terminals until it touches that connected with the line wire in question, when the circuit is re-established, and the feeler is held fast; a pointer connected with this feeler now shows the number of the post with which communication has been made. A second train of wheelwork now comes into action, sending electric impulses down the line to work an escapement in the lamp box. This escapement carries the index round the indicator until it rests at zero, when the circuit is broken. The number of impulses sent shows the position at which the pointer originally stood, and as the clockwork is geared with an index, this position is reproduced on the dial of the central station, and thus the communication from the policeman is reproduced. Both indexes are then put back to zero by a crank handle, which also winds up the clockwork.

When the central station wants to communicate with a lamp post the corresponding wire is coupled to the instrument by a flexible connection. At the same time a much more powerful battery than the one previously employed is put in circuit, and impulses are delivered into the line by turning the index of the sending dial. These impulses work an electro-magnet in the lamp box. At the first movement this trips a catch which allows a weight to turn the gas up full, and to raise the red glass. As





it continues to work it moves the index of the receiving dial step by step with that of the sending dial, and thus the two point to the same message.

Fig. 1 shows the apparatus at the central office, the upper part containing the two dials on which are read the number of the lamp post from which a signal is being received and the signal itself. At the lower part is shown diagramatically the signal transmitter and the telephone. Fig. 2 shows the receiving instrument in vertical section. Fig. 3 shows the instrument with the door opened, the left-hand side displaying mechanism fixed to the back of the case, and the right that fixed to the rear side of the door. The number dial (Fig. 1) is divided into 100 parts marked with corresponding numerals, but it is capable of indicating any number up to 300. When the number exceeds 100, one of the small apertures D D is uncovered, and shows the figure 1 if the number is between 100 and 199, and 2 if it is between 200 and 300. All the wires from the lamp posts end at the terminals L L in the gang-switch at the upper part of the instrument (Fig. 2), there being as many terminals as there are wires. Each terminal L is connected to a terminal O, of which there are three circles, each containing 100. In connection with the gang-switch there is a contact maker *i* having spring contact *z*, which in the normal position press against the terminals L, and connect them altogether. The contact maker is pivotted; it is shown in dotted lines in the position it assumes when waiting for a message, and in full lines in the position when a signal has been received and the clockwork is moving the indicators. When in the dotted position the long tail of the contact maker engages with the lever *t*, which is itself held by its other end being caught on a projection of the armature *w* of the electro-magnet Y. When a signal is received from one of the wires the current passes from a terminal L to the contact maker *i*, and through its axis *k*, and a finger thereon, to two fixed contacts 2, 3, by which it is conveyed to the magnet 19 (Fig. 3). This magnet attracts its armature, and draws the detent 16 out of the ratchet wheel 17, thereby releasing the train of clockwork which operates the long indicator (Fig. 1). At the same time a new circuit is established through the contacts 20, 21 (Fig. 3), and the current is directed through the magnet Y. This magnet attracts its armature, releasing the trip lever *t* and the tail of the contact maker. This latter moves into position shown in full lines, striking the bell as it does so, while the finger on its axis breaks the contacts at 2, 3 and makes those at 4, 5 (Fig. 3). The left-hand clockwork train (Fig. 3) is now working and, through the clutch arm 7 and the pin 6 (Fig. 2), is driving the wheel Y. This wheel carries three brushes T, which trail over the three rings of terminals O, connected with the line wires. Supposing that the wire along which the call has been sent is connected to a terminal in the outer ring, the moment the brush touches the terminal a fresh circuit is established. The current now flows through the magnet *e* (Fig. 3) and the magnet 27. The former trips the catch *b*, stopping the long hand, with all the wheelwork connected with it, at the position corresponding to the number of the post from which the call has come. If the terminal happens to be in the middle or inner ring, one of the magnets 44, 44 is also included in the circuit, and trips a catch, which allows a shutter to rise and reveal the number on the corresponding disk D (Fig. 1).

When the magnet 27 attracts its armature it releases the right-hand train of wheelwork by lifting the pawl 29 out of the make-and-break wheel 33. This wheel then commences to revolve, and as it does so it sends successive currents to the line through the contact spring 35. Each current acts upon a magnet in the lamp post, and by means of an anchor and escapement wheel moves the distant index step by step round its dial until it reaches the zero point, when the circuit of the distant sending instrument is broken, stopping the current in the line and in the magnet 37. The detent 39 then drops back and stops the train. The short hand (Fig. 1) has been moving step by step with the make-and-break wheel, and when the latter stops the hand points to the same message as that to which the index of the sending dial had been placed.

If the signal received should be "register," the wheelwork is arrested at a point where a connection is made cutting the magnet 37 from the main line; and the circuit is now from the sub station to the relay 87, thence through the battery to the ground plate. In the local circuit of the relay is the register 88, which is a Morse receiver. The object of this is to receive and record the policeman's number, as will be explained later. If the signal received is "telephone" the operator at the central station fixes a flexible connection between the line terminal and the telephone, and then he can speak with the policeman at the distant lamp post or sub-station. At the conclusion of a signal the parts are put back into their original positions by turning the handle 52 (Fig. 1). This raises the rod 45 (Fig. 3), on which are various projecting arms, such as 66, 67, 68, and these take hold of the apparatus which have been moved and return them to their places ready to receive another signal. The motion of the rod also winds up the clockwork trains.

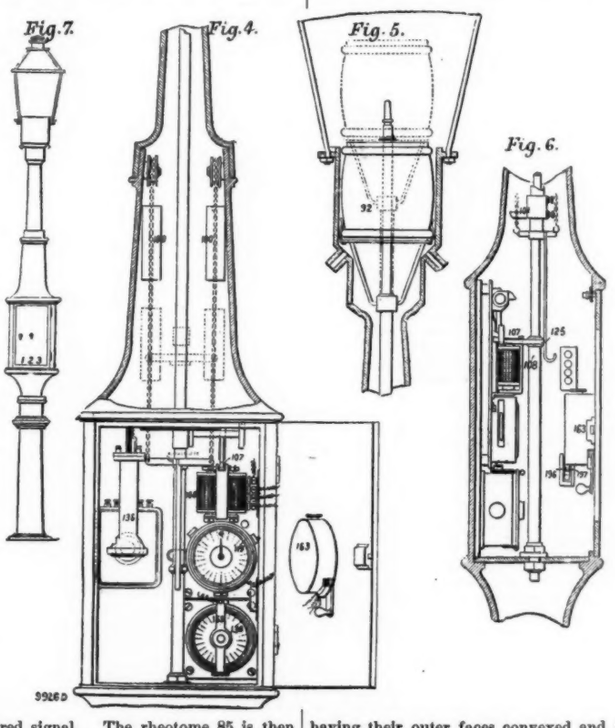
The apparatus so far described is designed only to receive a signal at the central station from one of the sub-stations, that is, to enable the inspector to understand the information sent to him by his subordinates. If the inspector wants to communicate with one of his men on his beat, he employs the apparatus shown in the left-hand corner of Fig. 1. This is the variable signal transmitter, consisting of a magnet 75, the armature 76 of which acts upon an anchor-shaped pallet 77 gearing with an escapement wheel 79. Upon the axis of this wheel is an index moving over a dial divided into sections, and each marked with a question or message, such as "Has the procession started?" "Do you want more help?" and the like. There is a commutator on the index spindle, provided with an insulated strip 83 let into its surface and engaged with two spring fingers 84. When the index stands at zero the insulating strip breaks the circuit of the instrument. There is a flexible connection and plug 86 by which the transmitter may be inserted in any of the spring jacks which are in the lines, for the purpose of cutting the receiver out of line and of putting the transmitter into any of the lines leading to the sub-stations. In operating the transmitter the index spindle is turned until it points to the desired signal. The rheotome 85 is then operated by its handle to make and break the circuit, so as to step the indicator of the transmitter back to its zero position. The indicator at the sub-station being on the same wire, shows the same motion, and as its dial is marked in the inverse sense to that at the central station, its index points at the end of the operation to the same message as that at the central station.

The apparatus at the sub-station is shown in Figs. 4, 5, 6 and 7. It is comprised within a lamp post of special design (Fig. 7) provided with a red globe, 92, by which the light can be surrounded as a call signal. At a convenient height there is a door, 123, which can be opened by a key to disclose the parts shown in Fig 4, in which 119 is the receiving indicator, 138 the sending instrument, 136 the telephone, and 163 the citizens' call. The globe, 92, is carried on a sliding tube which is constantly urged upwards by the two weights, 100. It is normally held down by the engagement of the finger 101 (Fig. 6), with the catch 103, this latter being locked by the armature 107 of the magnet 108. When a signal is received from the central office the armature is attracted and releases the catch, allowing the red glass to rise and surround the flame. This armature is likewise connected by a rod with an anchor, engaging an escapement wheel in the receiving instrument 119, and at every pulsation of the current the index is moved forward one division of the dial, until it points to the message which it is desired to send. When the policeman has opened the box and read the message, he pulls down the globe by the hook 125, and as he does so, a projection on the slide encounters an arm projecting from the receiving instrument and puts its index back to zero. If an answer is required the man may reply by telephone or he may use the said dial just as if he were calling up the central office. He turns down the hasp 155 of the sending instrument, breaking the circuit, and then adjusts the index to the required message. The replacing of the hasp completes the circuit, whereupon the indicators (Fig. 1) at the central station make their strokes.

The "citizens' call" 163 is a special appliance to enable private persons to secure the presence of a policeman. It is operated by a key which can be inserted from outside the box (Fig. 7) and turned, but which cannot be removed until the box has been opened by a policeman. The effect of this is to make the number of the sub station and the words "citizens' call" appear (Fig. 1) at the central station, whereupon the inspector causes the red light to be displayed to attract the nearest policeman. Each citizen's key is stamped with a number and its owner registered in a book carried by the policemen of the beat.

The apparatus by which the policeman registers his number is marked 196-197 (Fig. 6). These pieces are sections of a small split tube, and are secured to the inner faces of spring plates so that their edges will come together without touching. These two tube sections together form a spring jack and a holder, and receive the circular plug of a policeman's pocket number registering box. This plug is composed of two metallic strips, having their outer faces convexed and respectively adapted to be received with the two tube sections of the spring jack of the switch, the said strips being insulated from each other. The number box contains a spring which can be wound up, a train of wheelwork, and a number wheel. This wheel, which is in the circuit of the box, when this is plugged into the switch, engages, when it is rotated, with an insulated spring finger in the same circuit, and makes and breaks the circuit according to the number of teeth on its periphery. The policeman winds his box by a small lever, inserts the plug, and then draws a releasing catch, when the number is automatically sent to the central station and received on the paper ribbon of the Morse ink writer.

If this description is clear it will be understood that no technical knowledge is required of the persons using the apparatus. All that is necessary is to set the index and to follow the very simple set of instructions. The sending index at the sub-station is returned to zero by the simple receipt of the message at the central station, and this of itself shows that the message has arrived. If two or more sub-stations telegraph at once, the one which first sets the apparatus in the central station in operation obtains the preference. As soon as the apparatus is returned to its normal position by the crank 52, the number hand again starts and stops at the terminal of the first wire it reaches in which a current is running. If there be a third line working, the apparatus will start again as soon as it is readjusted, and so on. There is thus no chance of the messages conflicting, and the worst that can happen is a little delay.—*London Engineering.*



TELEGRAPHIC

.... A large force of men is engaged in changing the Western Union Telegraph Company's wires in Kansas City, Mo., from iron to copper ones. The work will be completed in about two weeks. About 300 miles of copper wire will be put up within the city limits. The cost will be about $15,000 to $20,000.

.... The Western Union Telegraph Company had a car load of telegraph poles transported from Fort Fairfield to Lewiston, Me., and then distributed along the line to Danville Junction, where the lines are being rebuilt. While the poles were being thrown off, a hen appeared from a sheltered spot where she had been hiding and riding from Aroostook. The hen had a strong sense of fitness of things, and not desiring to appear in the light of a tramp stealing a ride, laid six eggs on the car as pay for transportation.

The Destruction of Telegraph Insulators.

Insulators have long been considered by the public as proper objects on which to experiment in the ancient art of stone-throwing, and in Belgium it would seem that the peasants have a special predilection for this kind of sport. M. Emile Pierard, telegraph engineer to the Belgian government, reports that, owing to the great destruction of telegraph insulators, it became necessary to employ some of an unbreakable nature. It was found, however, that these insulators, which were sunk in a protecting cover of galvanized iron, were both extremely heavy and extremely costly. Another system was therefore adopted. It was thought that the large white insulator generally employed naturally attracted the attention of individuals of a destructive turn of mind, and it was decided to experiment with one of a less obtrusive color. The porcelain enamel was colored a greyish brown by mixing a silicate with it. This process did not impair the insulation properties in any marked degree, and the color of the posts being also greyish brown, it was difficult to distinguish the insulator from its support. A line 22 km. long was selected, and provided with 102 insulators of each kind, arranged alternately. In one year 25 of the ordinary white insulators were broken, but only 13 of the colored ones. Taking into account the somewhat higher price of the colored insulators, but not the cost of labor in replacing the broken insulators, these figures mean an economy of about 42 per cent. All broken white insulators are now replaced by brown ones, and if these are broken, protected insulators are substituted.

Music over the Wire.

An extremely interesting and novel exhibition of long-distance telephoning was given at the Hotel Lafayette by the Long Distance Telephone Company. In response to special invitations, Collector Thomas V. Cooper, Electrician David Brooks, Dr. Robert W. Martin, Fred. M. Walters and many ladies, gathered in Parlor C.

There were many exhibitions given including talking with Boston and Buffalo and a cornet solo from the Bean City. The latter, the themes being "Home Sweet Home" and "Robin Adair," was clearly and distinctly given through the large receiver. A speech from Boston was also heard plainly and two songs from New York brought forth applause.

The gem of the evening was the transmission of a selection of the "Grand Duchess" from the New York Casino by means of an instrument placed on the stage. The selection made was the solo and chorus, "The Sabre of my Sire." Miss Lillian Russell's voice was easily recognizable as she surrendered the sword to her *Fritz*. Every note was clear and every thrill and run came out without a fault, the orchestral accompaniment and the chorus traveling the 90 odd miles over the wires perfectly. At the end of the second verse the applause in New York told Philadelphia that the audience was pleased and the little company in Parlor C awaited the *encore*. It was granted, and upon the conclusion Philadelphia heartily applauded both the Casino artists and the wonderful invention.—*Philadelphia Times.*

* * It has been definitely decided to adopt electricity as the motive power on the street railway at St. John, N. B.

* * Electric railway news seems to have a monopoly of electrical affairs chronicled in the local press of the country.

* * It is proposed by the city council to extend the street car franchises of Indianapolis for 26 years. That's the way to do it.

* * The Tacoma, Wash., Railway and Motor Company is to be greatly improved and extended. Tacoma is an enterprising city.

* * The Robinson & Moon Street Car Company has closed a contract to furnish 50 cars for the Hinckley & Holmes Electric Company, of Milwaukee.

* * Electric launches proved so successful at the Edinburgh exhibition, showing they could travel six knots an hour carrying a heavy cargo, that it is now proposed to start an electric ocean ship.

* * The Saginaw, Mich., electric railway wires were recently cut and traffic was stopped for three hours. It is charged that the cutting was done at the instance of the Michigan Central Railroad Company, as the wires were strung too low to suit that corporation.

* * Advices from Newburyport, Mass., of recent date, report as follows: A big land purchase has just been made here by the Newburyport & Amesbury Street Railway Company, and a power plant is to be established for running the electric lines of the company in this section. The erection of a brick building is to begin at once, 100x70 feet. It will be equipped with a new engine and two large dynamos. The purchase includes 25 acres, and on the space not used for power house will be erected paint, machine and repair shops. This improvement will necessitate the expenditure of about $100,000.

Traction Cells.

It was recently stated by Mr. Frank Wynne that he had found it impossible to obtain traction cells from whatever source that would stand more than 200 dischargings. This rather startling assertion, made in a pamphlet advocating a different system, was certainly laid open to the idea that disparagement of accumulators in favor of conduits was the aim of this remark, and we objected to it at the time. We were more than surprised to find it also maintained by a well-known electrical engineer. It may be understood what such a thing would mean; for 200 chargings if used only once a day would mean the life of a battery for a tramcar of little over half a year; while if charged twice a day, as often would be the case, this would mean a life of one-fourth of a year, or a depreciation of 400 per cent. per annum. This seems utterly ridiculous from what is known and published on the behavior of accumulators. But it was maintained that the data of people having to do with accumulators are persistently erroneous and misleading, and the truth with regard to storage is yet to be brought to light. These statements seem to require some investigation, and we therefore call upon Mr. Frank King, engineer to the Electric Construction Company, who now manufacture and supply the E. P. S. cells. Mr. King emphatically says that they have cells in practice which have given 450 dischargings. Even after this number of discharges the battery had only certain plates that required replacing, and the most part was in good condition. This is from actual work with traction cells, and there should be no difficulty in working the batteries for a year without repairs.—*London Electrical Engineer*

Automatic Electric Welding Machines.

BY HERMANN LEMP, BEFORE THE GENERAL MEETING OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, BOSTON, MAY 21, 1890.

Among the latest achievements in electrotechnics, stands prominently Prof. Thomson's electric welding process. The broad underlying principle has so often been described and exhibited by its able discoverer and others, that to repeat it again would be imposing upon your patience. The evolution of a new process and its reduction to practice for commercial purposes, especially if the leading elements of its working are novel in themselves, must necessarily open a vast field for investigation. Such is the case with electric welding, and with a view of showing the commercial apparatus of to-day, it will be necessary for me to state the electrical and mechanical requirements which led to its construction.

The reason for which machines have been invented has been for the purpose of reproducing faithfully and constantly a set of conditions ne essary to obtain a certain result. When the conditions in any case are few and the product simple, generally one design of machine will be sufficient. With an increased number of conditions, however, the complexity of the apparatus increases rapidly and demands in many cases, subdivision into different processes to be executed by separate machinery. What constitutes skill, in a working man, for instance, is the ability to co-ordinately reproduce a number of operations or movements; to be, in other words, a perfect machine, or to produce the same result even if other conditions than those previously contemplated should arise.

To secure uniform results in the practice of a difficult operation, there are two ways possible:

1. To employ skilled help for the complex portion of the work alone.

2. To substitute for the more complex portion of the operation one more readily controlled.

The ordinary welding process requires the greatest skill at the hands of the blacksmith for heating the metals to the proper temperature and at the right spot, while preventing the accumulation of cinder or scale. While skill may be successful with metals of high melting points and low conductivity for heat, easily fusible metals and especially good conductors baffle all attempts as long as an exterior heating source is employed.

The electric welding process has, as you know, not only made it possible that operators not particularly skilled in the art of blacksmithing can produce good substantial welds, but has created an art equally adaptable to all metals and combinations of metals.

The following are all the metals, alloys and combinations, so far actually welded with success by the Thomson process.

METALS.

Wrought iron, cast iron, malleable iron, wrought copper, cast copper, lead, tin, zinc, antimony, cobalt, nickel, bismuth, aluminum, silver, platinum, gold (pure), manganese, magnesium.

ALLOYS.

Various grades of tool steel, various grades of mild steel, steel castings, Chrome steel, Musshet steel, Stube steel, Crescent steel, Bessemer steel, cast brass, gun metal, brass composition, fuse metal, type metal, solder metal, German silver, aluminum alloyed with iron, aluminum brass, aluminum bronze, phosphor bronze, silicon bronze, coin silver, various grades of gold.

COMBINATIONS.

Copper to brass, copper to wrought iron, copper to German silver, copper to gold, copper to silver, brass to wrought iron, brass to cast iron, tin to zinc, tin to brass, brass to German silver, brass to tin, brass to mild steel, wrought iron to cast iron, wrought iron to cast steel, wrought iron to mild steel, wrought iron to tool steel, gold to German silver, gold to silver, gold to platinum, silver to platinum, wrought iron to Musshet steel, wrought iron to Stube steel, wrought iron to Crescent steel, wrought iron to cast brass, wrought iron to German silver, wrought iron to nickel, tin to lead.

But Prof. Thomson was not satisfied with this progress made above ordinary welding, and early recognized the importance of a machine in which all conditions for successful operations are mechanically controlled to produce uniform results, be rapid working and require little or no attendance.

Such machines, now known as automatic welding machines, have proved to be of special importance in connection with easily fusible metals, enabling the successful welding of aluminum, silicon and aluminum-bronze, which require, even with the electric process, a considerable skill.

Before entering into a detailed description of the automatic welder, a few *general* data on welding will be in order.

The Thomson process of electric welding can and has been worked by means of continuous or alternating currents; secondary batteries or unipolar machines may and have been used. There are such conditions as transportability, absence of motive power, situation in continuous distribution district, A. S. F. which may make it advisable to use the continuous current. The alternating currents have so far been the best adapted to be economically produced of large volume at low E. M. F. They are easily and economically controlled, allow of being distributed at high pressure with small conductors and of being reduced to working pressure wherever needed. They have, however, another beneficial effect, which is of importance in all welds of large sections.

It is a well-known fact amongst manufacturers of incandescent lamp filaments of large section that the inner portion in a filament is apt to be overheated. In treating filaments as used in the now commercial series lamp, in hydro-carbon atmosphere, the writer thought once to produce an extra good quality of carbon by starting with an extremely thin base, .004 inch thick and obtaining a filament 90 to 95 per cent. of which consisted of hard, gray, lustrous carbon. He thought to extend this process to the manufacture of arc light carbons and even produced pencils of about ¼ inch diameter. What was his surprise, however, to find that, although the lustrous surface presented at all times a dense gray structure, the core lost this character after a certain thickness of carbon had been deposited. In fact, a number of concentric layers would be discovered from the inmost graphite to the dense gray, semi-crystalline at the outside.

This action can, in my mind, only be attributed to the over-heating of the carbon particles in the inside. A similar action takes place in a bar of iron if heated by an electric current. The surface exposed to radiation will be at a lower temperature than the core. It is true that the heating of the metal will increase its resistance and thus tend to equalize the temperature, but not enough in all cases. By the use of alternating currents we gain, however, an assistance in the self-induction. The effect of the latter is especially marked, and has a tendency to concentrate the heat on the surface.

If there is any place which receives more current than another, the effect of the self-induction is emphasized by the fact that the surrounding part is cool and its permeability is greater than the part traversed by the surplus of current. With very large, and especially wide metal pieces, the unevenness of distribution may be remedied by approaching iron masses to create at a given spot a greater self-induction or counter E. M. F., diverging thus the current from that section. Prof. Thomson has early recognized the importance of, and patented a device, to *prevent* the heating of metal at a given spot by creating locally increased self-induction or magnetic effects.

In view of this, an experiment almost daily witnessed by us, it is interesting to note the paper controversy between parties disputing the priority of a device which is to produce exactly the opposite result with, however, the same means and conditions.

Two methods of distribution are in use, the direct and the indirect. In the former, an alternating current dynamo is used, having two windings on the armature, one of which furnishes currents rendered continuous by a commutator to excite the field magnets, and is controlled by switch and rheostat; the other, consisting of a single turn of heavy copper cable, furnishes the welding currents, which is led through collector and brushes to movable copper clasps suitable to receive and guide the welding specimens during the operation.

In some other forms the field magnet is the movable part, in which case no heavy currents have to be carried through collector and brushes. No direct welders are built at present for currents larger than 4,000 amperes.

The indirect method of distribution is almost exclusively used to-day. It consists in its simplest form of one alternating current dynamo, self or separately excited, and one welder, which is a transformer with the necessary clamping and operating appliances. The self-exciting dynamos used are from 1,000 to 20,000 Watts output, and may be regulated by means of a reactive coil to give a varying E. M. F., never to exceed 300 volts.

They are substantially built to withstand sudden strains, have self oiling bearings, brushes are never to be moved and perfectly sparkless, requiring no other attendance but cleanliness.

The winding on the transformer being once for all set, variation in the E.M.F. has to be obtained either by varying by hand the initial E.M.F. of dynamo, or to excite a dynamo to the lowest potential required, it being so compounded as to give with the maximum work the increased E.M.F. or finally to maintain a constant E.M.F. at dynamo under all loads and vary the E.M.F. at the transformer by interposing a variable resistance or preferably self-induction. The transformer itself may be built so as to give a different ratio of conversion, either by moving the primary and secondary relatively to each other or by shunting lines of force by means of an iron bridge between primary and secondary, or by altering the number of turns in primary or secondary by a switch.

When a single plant is used, viz., one dynamo and one welder, it is the dynamo generally which if separately excited is regulated by means of a rheostat in the exciter circuit, or by a reactive coil in series with exciting coil on armature if self-excited. The only thing different from similar installations is the break-switch which is operated by a foot treadle and automatically opens the circuit when foot pressure is removed.

This prevents any mishaps when operated by uninitiated persons as all action ceases when one leaves the apparatus. The primary voltage never exceeds 300 volts with 100 alternations or 50 complete cycles per second. Nothing but the very best insulation is used in the primary wiring. It is deemed necessary to protect the customers not only against any shocks, but even against the scare of one, and we recommend to permanently ground the secondary, which in welding apparatus is virtually the table and pressure devices.

For some work which requires to be done at great speed, a second method is resorted to, that is, to keep the field constantly excited by fixing a variable reactive coil in a given position just enough to produce about 150 volts, the lowest E. M. F. required. The proportion of the field magnets, the E. M. F. of exciting coil and the resistance of a shunt to field are such as to produce an over-compounding of 100 per cent. in this case with largest current in primary.

This method of regulation is very nice, as it is absolutely automatic, responds quickly, the field of the dynamo not requiring to "build" every time from residual magnetism alone. We sometimes call it "cubic compounding" as it produces a constant heating effect for variable cross sections and variable lengths as well. With this modification, the wiring is slightly altered, the break switch breaking only the main circuit, leaving the exciting circuit permanently closed.

The methods so far described are only used when a single welding machine is to be operated. It was early recognized that if the process is at all to be used on a commercial basis, that at least the generating of the necessary currents should be limited to as few machines as possible. It required, in other words, a dynamo giving a nearly constant E. M. F. of sufficient capacity to feed a number of welders while maintaining for each absolute independence.

Since all welding for a long while to come will probably be operated in isolated plants, the dynamo is to be placed in the hands of an engineer generally not an expert in electrical matters, and has, therefore, to be easily attended and free from all the little faults and kinks which are at present the sole consolation of the dynamo tender. One of its prime requirements is close automatic regulation under all loads.

Constant potential, self-regulating dynamos are manufactured in various sizes and are self-exciting up to 30,000 Watts output. Dynamos with larger output are separately excited, but also self regulating. The methods employed to obtain regulations are novel and will form the subject of another paper at some future date.

I would simply state that either constant potential or a percental increase with load can be obtained and that the regulation will respond even if the load consists of self-inductive translating devices.

I lay some stress on the regulation of the dynamo for the reason that the generators are not to be placed in the hands of special attendants as in case of a central station, but have to deliver their currents under constant pressure whatever may be the conditions of work they are subjected to; even an automatic regulator would hardly be able to follow the rapid variation of load.

The following conditions influence the perfection of the work and are variable with different materials and sizes:

1. Projection of the abutted pieces in the path of the current.

2. E. M. F. of welding current as controlling the strength of current flowing.

3. End pressure applied to force the abutting ends into each other at welding heat.

4. Interruption of current at proper time.

1. The projection of the abutted pieces varies with the diameter. It has been found that for copper a projection of two times the diameter for each clamp gives the most economical results. With steel and iron, the most economical projection equals the diameter, and is for brass one and one-half times the latter.

The projections sensibly effect the energy required and the most economical one depends upon the heat conducting properties and specific resistance of the specimens. Accordingly high conducting bodies require longer projections, highly resistant ones short projections. Conductors of larger and smaller diameters may be welded by giving

to each its respective projection. In the same manner may wires of different materials be joined to each other.

It is easily understood that since unequal projections on different sized conductors produce the proper heating of both at their junction, equal projection of equal sized conductors will be required. All other conditions neglected, it is important to keep the projection for a given size and material constant.

2. The E. M. F. required depends upon the projection and the resistance of the material to be welded. For larger cross section, the specific self-induction plays an important role, and indirectly the shape of the specimen.

Another factor affecting the E. M. F. is the resistance between clamps and material and the resistance of copper conductors. The E. M. F. required for iron and steel is nearly double that for copper, and would be four times if equal projection were used for both.

A certain drop of E. M. F. will be found from the clamps to the specimens. This drop is rather low on material having naturally bright surfaces, as, for instance, copper, brass, German silver, tin or even cold rolled iron and steel. For a large class of work, however, especially in carriage hardware, the surfaces to be used for contracts have a light scale left after passing through the rolls, which has either to be removed by grinding or filing or to be overcome by the E. M. F. of the current. In a good many cases, the introduction of a special process of cleaning is deemed to be more expensive than to use a little extra power to work through the scale.

3. For uniformity of result the end pressure required to press the abutting specimens into each other at welding heat is of more importance than any of the former agencies; this is, in fact, the one which controls and rectifies any inaccuracies in the former conditions. If the pressure necessary for a given size and material is used, the weld cannot be performed until the metal has acquired the necessary plasticity to yield to the pressure. If, for one reason or another, the E. M. F. and, consequently, the current should have been too strong, the time necessary for welding alone is affected, and in this case shortened. The bars will, however, be united at the same temperature and with the same force, whatever the time may have been used to bring about the plasticity necessary. The pressure will, in some respects, influence the heat by forcing the metal into each other at either higher or lower temperature, and by so doing cause the action to be interrupted at an earlier or later period, as may be required.

The pressure required varies with the material, and is approximately 1,800 pounds per square inch for steel, 1,200 pounds per square inch of iron, 600 pounds per square inch of copper; it varies also with the area of cross section as indicated by its being expressed a function with the surface as one of the factors.

4. The interruption of the current as soon as the weld is completed is important for all easily fusible metals. When two copper wires are welded together, the welded portion being increased in cross section owing to the end pressure, if the current is not interrupted a large portion of the conductor on either side of the weld, including the latter, become heated and will melt and be torn asunder before any pressure device could follow and over-bridge the gap.

The current should, therefore, be interrupted as soon as the weld is completed. It is also sometimes required that the parts to be welded should be of a certain predetermined length, in which case the interruption of the current as soon as the allowable distance has been reached is essential.

All these conditions are maintained constant in the automatic welder before us, which is the first commercial type of its kind. This welder is not entirely automatic in the strict sense of the word. The degree of automatic action has to be considered for each individual object separately. This machine contains, however, the leading features as covered by Professor Thomson's patent, June 26th, 1888, No. 385,022, with a few improvements in mechanical construction. The capacity of the machine is nominally copper wire No. 6 to No. 17 A. G. It will, however, weld larger and smaller sizes. It weighs 130 pounds complete; the secondary is one solid copper casting of a cross section resembling a hollow, square box, with one of the sides removed.

This casting is firmly screwed to an iron table. A saw cut at right angles to the plane of loop creates the two poles, one insulated from the table, the other constituting a V-shaped bearing suitable to receive a sliding, clamping device.

The hollow part of the secondary is to receive the primary coil which is separately wound in a form and insulated with special care. Two U-shaped laminated iron cores embrace primary and secondary.

It has been found that the best form of transformer is the one in which the primary and secondary coils are coaxially placed on an iron core, so as to oblige all lines of force generated by the former to cut through the latter. If the two windings are placed side by side on an iron core, or on opposite legs, there is a tendency to form consequent poles at the point where the two windings meet, due to the leakage of lines of force. The leakage will depend upon the distance between the two legs, and upon the length of magnetic circuit. It has been purposely increased and turned to advantage by Professor Thomson, for obtaining constant current in the secondary while the primary is supplied with constant E. M. F. When, however, constant E. M. F. in secondary is required, it is important that this leakage should be decreased to a minimum.

Various forms of secondary may be employed to work consistent with the above principle.

It is often found stated that when large quantities of alternating currents have to be conveyed through copper conductors, it is important to have the same laminated or subdivided in smaller conductors to reduce self-induction. This may be true to a certain extent. The shape of cross section is, however, far more important than the lamination.

An experimental compound conductor consisting of a number of flat copper ribbons in parallel showed a self-induction of *three* when the ribbons were closely packed, of *two* when separated into two parts and *one* when spread open like a fan.

The explanation for this was given to the Institute last year by Prof. Thomson when he showed self-induction to depend mostly upon the length of the lines of force surrounding a conductor when traversed by intermittent or alternating currents.

Returning to the subject before us, we find that the pole which is insulated from the table constitutes the stationary clamp. The uninsulated pole which is considerably larger, has on its upper side a long V-shaped groove parallel with the axis of the secondary. A movable copper block, also V-shaped, fits in the bearing and can be slid in the same forwards and backwards.

This movable block carries the second clamp. The current necessary for welding has to pass through this sliding contact. The welding of small copper wire, or any other easily fusible metal, is a very difficult thing if special apparatus is not used. The current required is very large, several hundred amperes for wire not larger than No. 17 A. G.

The metal, when it reaches welding heat, readily melts away, and has to be followed by the movable clamp, so as to prevent the breaking of the circuit. This latter action, when it occurs, is so violent that a special device is necessary to prevent injury to the coil in case of such a rupture. The moving clamp, in order to follow the softening of the metal, has, therefore, to have as little friction as possible, and yet has to make a good contact to carry the heavy currents. The clamp is furthermore required to move in true guides, so as to abut the small conductors with their axes in line. The heating necessarily brought about when rapid and continuous welding is done, must not interfere with the bearing and cause the carriage to stick, through expansion.

All these conditions have been complied with in using the V bearings, the carriage being held down in contact by means of a heavy spring and a number of copper rollers being interposed between the carriage and the bearing. The copper rollers are simple, short pieces of one-quarter inch hard rolled copper wire, rounded at the ends. There are 16 altogether, eight towards the front and eight towards the back of carriage, equally distributed on both sides of the bearing.

A stationary rod at apex of bearing prevents the interference of the two rows of rollers. Between the two sets of rollers in front and in back, a bolt passes, applying the spring pressure, forcing the carriage into contact with the bearing. A pressure of 40 pounds may be employed, and yet the carriage will move freely. These 16 rollers have to transmit a current of approximately 3,000 amperes. They absorb about 20 per cent. of the total energy, which loss is, however, fully balanced by the reliability and simplicity of the device. This loss is, moreover, only on the maximum sizes, and becomes insignificant on small work.

An adjustable coiled spring pulls the sliding clamp towards the stationary one. In front and pivoted on a lever is the distance gauge which may be inserted between the two clamps. This gauge carries on a central disk a number of steel pins of varying lengths, but equal projection on either side of disk. These projections, if inserted between the two clamps, give the necessary distance required for a given size wire, the disk against which the wires are abutted insuring equal projection of both ends to be joined. On the back of app ratus a switch is located in the primary circuit, which is normally held open by a spring. By moving the handle to the right, the primary will be closed and the switch locked by a little catch underneath the table. A pin fastened to movable clamp will lift the catch and release the switch, thus opening the circuit.

An intermediate lever between catch and pin operated by a sliding rule which serves also as an index, permits of varying the point of cut-off, which has to be in a certain relation to the distance between clamps. The position of cut-off tension of spring distance between clamps corresponding to each other are marked with the same figure, which is also inscribed on a wire gauge fastened to the welder. By inserting a wire into the gauge, the number read will give the necessary adjustments at once.

If, by imprudence, the switch should be moved to the right while no stock is inserted and the clamps in contact with each other, the switch cannot be locked and the fuse in primary will be blown without, however, causing any damage.

The insertion of the distance gauge between clamps locks the switch so that primary can only be closed after withdrawing the gauge.

The operation is as follows:

1. The wires to be welded are gauged.
2. The distance gauge and cut-off are set to correspond with number on gauge.
3. The movable clamp is moved to the right and gauge inserted.
4. Both wires are securely clamped, care being taken to abut the ends squarely against the disk.
5. The gauge is withdrawn.
6. The switch is moved to the right.
7. The reactive coil moved towards a position of minimum reaction, and restored to maximum after weld has been completed.
8. The clamps are opened and the weld removed, after which the operation can be repeated again.

If a good many welds of the same size material are to be made, the reactive coil may once for all be set in a given position and the switch alone to be operated.

Welds made with the automatic machine have attained an uniformity not attainable with very skilled operators working without it. In fact, small, easily fusible wires can scarcely be welded with certainty with ordinary apparatus. For aluminum especially the automatic apparatus is needed.

The reactive device used in connection with welders is the type recently described by Prof. Thomson in which a cast is made to more or less cover the primary, the self-induction of which is to be altered. To obtain still a large range, the windings of primary can be coupled in series or multiple series or multiple by a switch in base of coil.

As mentioned before, the welding of easily fusible metals may sometimes cause a rupture of the secondary circuit which, owing to its violence and volume of energy, may cause a burn out of the primary if not guarded against. This danger is not very great in the automatic machine, since the end pressure does not depend upon the attentions of the operator. A special device is, however, used and an extra precaution against all emergencies.

Breaking a high tension circuit rapidly is not easily done. An arc generally follows the break and this lengthens the time of the rupture. If the voltage of the circuit to be broken is so low that over the slightest distance an arc cannot follow, the break will be instantaneous. This is the case with the secondary circuit of welding transformer. The voltage being ordinarily only one volt would even if increased ten-fold not be able to maintain an arc. However, multiplied in the primary, it will cause E. M. F. sufficient to pierce through the insulation as ordinarily used. This action is similar to a Rhumkorff coil in which the interrupter is caused to break under oil or water.

This discharge is taken care of by a special apparatus, the description of which I reserve also for another communication to the Institute.

While the machine before us is only one type embodying the principle features contained in all, others have been manufactured, or are in process of construction, in which the automatic character has been carried out even farther, as in the welding of rings and chains. I am not permitted to give a detailed account of these letters at the present time, but would say that the present model in its first form is able to produce 250 feet of chain in a day without any attendance to speak of, the plain wire being fed into the machine at one end and the complete chain coming out at the other. The automatic principle is, however, not confined to small conductors. We have welders with 40,000 watts output, capable of welding one-inch copper or two inch iron, constructed and working daily on that plan.

The projections are determined by adjustable stops, the pressure, the most important of all, is hydraulic and regulated by an automatic reducing valve, the exhaust being used for cooling clamps at the same time. The primary is controlled by adjustable re-active coils from a constant potential circuit and is interrupted at the proper time by the clamps. While not all machines today are operated on this plan, I am convinced that the evolution of the welding process tends in that direction and that the welding in future will be, in the full sense of the word, a purely mechanical operation.

ELECTRIC LIGHT NEWS

—— Prospect Park, at Niagara Falls, is to be illuminated by arc lights.

—— Electric lighting in the great Northwest is probably increasing. Western cities are taking the lead in electrical work.

—— In connection with the visit of the Duke of Connaught and party to Niagara Falls, it has been arranged to have the American Falls illuminated on Saturday night, and each night thereafter during the season.

—— The Edison exhibit at the Lenox Lyceum, New York, will be shown at the Minneapolis, Minn., Exposition, this Fall. Mr. L. Stieringer will have charge of the electrical work, which means that it will be thoroughly and artistically done.

—— The Westinghouse incandescent light is to be employed at the far famed Bar Harbor, on the coast of Maine. The Westinghouse Electric Company has just closed an order with Bar Harbor people calling for 2,250 lights capacity in generating apparatus of the alternate current incandescent type.

—— Supt. Maher, of the Albany Electric Illuminating Company, displayed sections of electric light wires in the mayor's office last week in proof of their perfect insulation. One sample, which had been in use ten years, only had the outer of the three protective coatings worn of. Another, eight years old, was not frayed in the least.

—— The Citizens' Electric Light Company, of Braddock, Pa., has been obliged to increase the capacity of its incandescent lighting plant. A contract was made with the Westinghouse Electric Company a few days ago to furnish a 750-light alternate current dynamo. This addition will give the company a total capacity of 1,400 lights.

—— A telegram from Fort Wayne, Ind., says the Fort Wayne Electric Light Company has brought suit in the United States Court against the Goshen, Ind., Electric Light and Power Company for infringement of patent. The complaint alleges that the Goshen Company has been operating electric light machinery on which the Fort Wayne Company holds an exclusive patent. The case will be tried in June.

—— Prof. Elihu Thomson, of the Thomson-Houston Company, in refuting the charge the other evening that Lynn's great fire was caused by electric wires, conclusively proved that the explosion of an oil stove, caused by a draught through an open door, was the starting point of the fire. To clinch the argument he asserted that the oil stove had been exhibited. Mr. Thomson regretted that the draught and the open door had been omitted from the show.—*Boston Record.*

—— An experiment with electricity for tanning purposes, was lately made in England. The process was accomplished in a revolving drum, 12 feet in diameter and eight feet long, rotating at eight revolutions a minute. Turpentine and tannic acid were used to saturate the hides, and a strong current of electricity was caused to flow from a metal band which runs around the interior of one end of the drum to a corresponding band on the other end. The drum, after revolving five days, was opened, and the leather appeared to be of excellent quality.

—— In addition to their present large plant, the central station of which is located corner Washington avenue and State street, the Edison Illuminating Company of Detroit will put into operation about July 1 a supplementary station with a capacity of about 3,000 Edison incandescent lights. The building for this at 24 West Willis avenue is finished and the machinery is being put in place. C. P. Gilbert is secretary and manager of the company. The Edison plant now operates about 12,000 incandescent lamps and about 130 motors, aggregating over 300 horse-power, and contracts have already been signed for about 50 horse-power more. These figures do not include the electric fans.

ELECTRIC CLUBS.

NOTES, NEWS AND GOSSIP FROM THE NEW YORK, BOSTON AND OTHER ORGANIZATIONS.

New York Electric Club.

Cyrus O. Baker, Jr., P. H. Alexander, H. D. Stanley and Gen. C. H. Barney, prominent members of the Club, spent Decoration Day in Washington. Fred. Royce is reported to have taken to the woods when he heard what was comiag.

The New York Jockey Club was visited by many Electric Club members on the afternoon of Decoration Day, and the beautiful grounds at Morris Park greatly admired. Secretary Kock, of the Jockey Club, is receiving many congratulations over the phenomenally successful opening of the Spring meeting, to which his energetic and intelligent efforts most largely contributed. These grounds are the finest in this country, probably in the world, and will be very popular this season.

Mr. James Swinburne, one of England's very capable electrical engineers, sailed for London on Saturday last. Mr. Swinburne, who is one of the editors of London *Industries*, was investigating some electrical work while here and made his headquarters at the Electric Club, where he has a number of friends.

The Decoration Day Parade was reviewed by a group of prominent Club members from a very conspicuous balcony of the Hotel Bartholdi. One of the gentlemen, who resembled Napoleon III, was the recipient of much martial attention. He was supported on the right flank by a Providence gentleman who ought to devote his time to politics—he's such a good wire-puller.

It's a Good One on Steve Holbrooke, and this is the way it happened. George Porter, the genial and popular, recently was on a Western cruise of pleasure, and one day landed in Tacoma, Wash. He knew Holbrooke was located in that city, and determined to play a practical joke on him. Porter was stopping at the Tacoma Hotel, which was but a short distance from Holbrooke's office. Going to the telephone, he called up Mr. Holbrooke, and the following conversation ensued:

"Hello!"

"Hello!"

"I want to speak to Mr. Holbrooke."

"This is Holbrooke—and if I wasn't in Tacoma, I should say that was George Porter's voice."

"It is Porter's voice. Do you get me, Steve?"

"Certainly, George, I hear every word just as plain as if you were in Tacoma. For heaven's sake, where are you, anyway?"

"Metropolitan Telephone Company, 18 Cortlandt street, New York city."

"You don't say so! Great Scott! how do they do it, George?"

"Long distance line to Chicago, and a telegraph wire from Chicago west."

"This is the biggest thing yet; any of the boys there?"

"Yes, they're all standing round me here."

"Event of the century! I don't hear much about these new things way out here till they get old. Keep it up, George, go on and talk."

When the joke came out the consequences may be imagined.

The "Electrical Engineer," of London, says the Electric Club, of New York, is "a model for England."

Boston Electric Club.

New Applications for Membership, both active and associate, are being presented every day.

The Pool Tournament has not yet come to a close, owing to a lack of interest on the part of some of the contestants.

Mr. A. B. Griggs has subjected himself to a peculiar diet, consisting only of meats and water. Like his friend Cleveland, he longs to be a light-weight.

Regular Monthly Club Meeting will be held on Monday evening, June 2d. As several important matters will be brought up for consideration and several distinguished gentlemen are to be elected to membership, it is expected that there will be a large number of members present at the meeting.

The Club's Anniversary.—The celebration of the third anniversary of the Boston Electric Club will take place on June 21st. It is predicted that the event will by far surpass any previous anniversary. To ensure this, preparations have already been commenced by the Club's energetic house and entertainment committee.

Kansas City Electrical Society.

The Society met in regular session in the Wales building, one evening, last week. Thus far the Society has been able to provide an excellent course of lectures. T. F. Clohesy's paper on "Electrical Tests" was postponed until the next meeting. President W. W. Smith, L. H. Gamp and E. Monahan, were listened to for two hours on electric light and telephone problems.

Harvard Electric Club.

The Club elected the following officers last week: President, G. H. Chittenden, '91; vice-presidents, E. H. Lewis, L. S. S., and A. N. Barron, '91; secretary, H. C. Smith, '93; treasurer, A. N. Barron, '91; librarian, G. T. Page, '91; executive committee, G. S. Curtis, '92, P. W. Davis, '93, and W. R. Westcott, '92.

Fort Wayne Electric Club.

This Club Dedicated its new parlors in the Schmitz building, on the evening of Decoration day. A pleasing musical programme was rendered and speeches were plentiful, witty and instructive. Hon. Robert S. Taylor, Prof. C. R. Dryer, Mr. Charles Miller, the "Duc de Slattery," Mr. Louis Freyer, Mr. Harry McKinley and Mr. Eugene McLachlin, were among the prominent people present. Mr. R. T. McDonald, general manager of the Fort Wayne Electric Company, was called to Chicago, and his absence was greatly felt. The rooms were brilliantly illuminated with over 100 incandescent lamps.

The Electric Club is destined to grow in scientific and social features and its inaugural reception and entertainment will give it high favor. The officers of the Club are: Chas. C. Miller, president; Harry McKinley, vice-president; Eugene McLachlin, secretary; Lewis Freyer, treasurer.

New Portable Testing and Resistance Sets.

Our illustrations on this page show the new series of portable testing and resistance sets now being put upon the market by Messrs. Queen & Company, of Philadelphia. These sets were all designed in the laboratory of Queen & Company, and are intended to meet the requirements of electric light men, telephone line construction, dynamo and motor manufacture and general testing. They will be found well adapted to the location of faults in telegraph and electric light lines, determination of armature and field resistance of dynamos and motors and the needs of government and other inspectors, as well as to general expert work.

FIG. 2.

FIG. 3.

The best and most complete set of the series is shown in Fig. 1. It is designed for work where considerable accuracy is required. The coils in this set are arranged in four rows, each row being made up of 10 coils of the same denomination. The blocks in each row are numbered from left to right and from zero to 10 while the longitudinal bars underneath have engraved upon them the denomination of the coils of that row. The connections of the coils are such that but one plug is required for each denomination. By inserting it in any block as many coils of that denomination are thrown in as may be indicated by the particular number engraved upon the block; thus, as the cut represents it, there are in circuit 369 ohms, *i.e.*, no thousands, three hundreds, six tens and nine units. Another special feature of this set is the arrangement of the bridge arms which are seen at the left; these are combined with reversing bars so that the proportional arms may be instantly interchanged, an operation which is absolutely necessary in many special methods. An additional advantage is that but six coils are necessary in the bridge instead of eight, as usual, to get the proportion of 1 to 1,000 or 1,000 to 1, thus making the set smaller and more portable. The bridge coils are 1, 10 and 100 on one side, and 10, 100 and 1,000 on the other. To effect this reversal two plugs only have to be changed. This use of this reversing arrangement in testing sets is said to be original with Messrs. Queen and Company, it having never before been employed except in the most expensive and elaborate laboratory instruments.

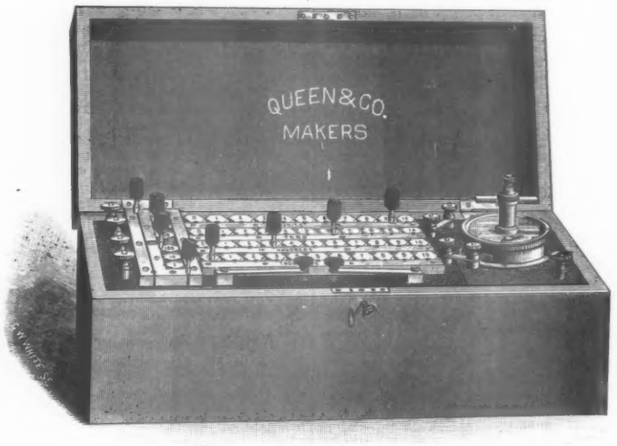


FIG. 1.

The coils are wound of the now famous platinoid wire which has a very high specific resistance, changing by but .0025 per cent. for each degree centigrade of temperature variation. They are adjusted by Prof. Wm. A. Anthony to an accuracy of from $\frac{1}{2}$ to $\frac{1}{10}$ of one per cent. while the bridge arms themselves are adjusted to a still higher degree of accuracy. The galvanometer is a successful adaptation of a laboratory instrument to the needs of portable work and is one of the most sensitive, complete and portable instruments ever combined in a set of this character. The wire is of several hundred ohms resistance and is wound so as to have a maximum effect upon the needle; the needle itself is an astatic one and delicately suspended by a very fine cocoon fibre so that there is practically no resistance to any deflecting force. By means of a very weak controlling magnet sliding upon the suspension tube, the needle can be made almost perfectly astatic and will show an appreciable deflection for currents as small as from $\frac{1}{3000}$ to $\frac{1}{5000}$ of an ampere; the brass box containing needle and coil is movable about a vertical axis so that the needle can always be brought to zero, whatever the position of the box as a whole. The whole galvanometer lifts out of its position in the case, and can be used independently or in connection with other apparatus if desired, three leveling screws being provided for leveling when so used. By closing the cover of the box the weight of the needle is automatically taken from the fibre and the latter protected from injury. The battery and galvanometer key are seen in the front of the box, and are independent of each other. The whole is mounted in a polished mahogany box with leather handles and lock and key, and measures, when complete, but 18 inches long by 6½ inches broad.

Fig 2 shows the same sort of a set without the galvanometer, and, consequently, is somewhat shorter. Both these sets have a range of measurement from $\frac{1}{1000}$ ohm to 10 megohms.

A set of much the same general character is shown in Fig. 3. The coils are made of German silver instead of platinoid, and are not quite so accurately adjusted, while the set is without the reversing arrangement found in the ones just described. The galvanometer is also fibre suspended, but without the automatic release; for this purpose a small set screw is used, which allows the needle to be lowered when not in use. The galvanometer is permanently mounted in the case, and is without the control magnet. The keys are combined into the regular double contact form. This set, as represented in the cut, has but three rows of resistances, viz. the units, tens and hundreds; it is also made with an additional row of thousands. This set is also made without the galvanometer.

Messrs. Queen & Company have already made and sold a large number of the sets described above. They have given as great satisfaction as all the work which comes from the laboratory of this well-known firm.

—— The Argentine, Kansas, Water and Electric Light Company has elected the following officers for the ensuing year: President, M. V. Ingram; vice-president, T. J. Enright; secretary, J. D. Cruse.

—— Among the recently established central station electric light plants operating the Westinghouse alternating current system, are: Grafton, W. Va., 500 incandescent lights; Lebanon, Miss., 500 incandescent and 40 arc lights; Emaus Borough, Pa., 25 arcs; Negaunee, Mich., 25 arcs.

KINDRED INTERESTS

The Cleveland Arcade Company, of Cleveland, Ohio, are putting in their building three large Ball engines.

The Rockport Water Company, of Rockport, Ind., have just received from the Ball Engine Company a 60 horse-power engine of their make.

The Fred. H. Whipple Company has moved its New York branch office from 18 Cortlandt street, to the Temple Court building, on Beekman street.

Chadbourne, Hazelton & Co., Philadelphia, have published a handsome circular in parchment covers, setting forth the good qualities of the Wenstrom dynamos and motors.

The Universal Radial Drill Company, Cincinnati, are sending out a neat calendar for June. The front of the card shows a handsome cut of a foot lever counter-sinker or post drill, and the reverse side has a cut of the company's large plant.

G. Wehr, Berlin, has sent us a series of his catalogues describing telegraph, telephone and other electrical supplies. The cuts of materials for domestic use show them to be first-class in every respect. Mr. Wehr's catalogues are very complete and well gotten up.

Queen & Company, Philadelphia, have issued a second edition of their catalogue 1-66, describing electrical testing apparatus and accessories. This is probably as complete a catalogue of its kind as has ever been issued in this country. The illustrations are especially good.

The Fort Wayne Electric Company, Fort Wayne, Ind., have issued a very handsome book describing the Slattery induction system and the Wood arc system. Heliotypes and handsome wood-cuts are plentiful, and together with the letter press make a very handsome catalogue.

The Phœnix Glass Company had by far the best exhibit of glass at the Exhibition of American Art Industry, of 1889, held last fall in Philadelphia. The judges' reports have recently been published and the following paragraph concerning this company appears: "While the exhibit of the Phœnix Glass Company was the only one in competition, the judges made a careful examination of all pieces exhibited, and came to the conclusion that in purity of metal, brilliancy of color, and general excellence, the Phœnix Glass Company exhibit is superior to all the others."

The American Steel Car Wheel Company recently received the following testimonial from the Robinson Radial Truck Company:

"In relation to the steel wheels manufactured by the American Steel Car Wheel Company for street cars, I beg to say that we used the first set of these wheels used on street cars. They have given us entire satisfaction, and we are now using them exclusively on all of our electric radial cars. Furthermore, the steel wheels on our first car has been running on the West End Railway since last fall.

"The wheels are tough, of good tractive qualities, and those we have used do not show any indication of chipping or of wear. We regard the wheels as of peculiar excellence, and we take pleasure in recommending them, especially for electric cars."

Robinson Radial Car Truck Co.,
(Signed) By Wm. Robinson,
General Manager.

Magnesia Pipe Covering.—The rate of increase in the demand for the magnesia sectional steam pipe covering is a noteworthy industrial fact. A gentleman closely identified with the Thomson-Houston Electric Company remarked to the writer a few days ago that in the earlier installations there was a disposition among electric light companies to look for the development of the near future only, and, consequently, to scrutinize very closely the price of different parts of the plant. But now a very much broader view is taken, and the electric plant planned much more carefully, with a more comprehensive understanding of future possibilities, while the best quality in the several items of the outfit was what the attention was chiefly given to. And he used as illustrations the facts that very much more expensive wire was now being used, and that while in the earlier days asbestos cements were used to insulate heated surfaces, the modern stations were being equipped with the magnesia coverings; that the use of the less effective non-heat conductors was too wasteful; that the best was the most economical, and that these economies contributed to lower prices for lighting and better profits. The new station of the Narragansett Electric Light Company, of Providence, is a case in point.

Another Telephone Tale.

A new long distance telephone story reaches us, this time from Paris. It appears that a number of different types of instruments were submitted to the commission appointed by the French Postal Administration to study the technical side of the telephone question. A trial was made on the metallic circuit line between Paris and Brussels, the distance between the two points being about 410 miles. Of the 20 different styles of transmitters tested, only one was pronounced satisfactory, and judging from the claims made for it, this instrument must indeed be a remarkable one. It is stated that by its adoption a much smaller gauge of wire can be employed than that at present in use, involving, for example, in the line between Paris and Marseilles, an economy of about 270,000 pounds of copper. The Director of Posts and Telegraphs has ordered 50 sets of these instruments for experiments at Paris, Lille and Marseilles. No technical details are to hand, so we give the information without comment and for what it may be worth.

Thomson-Houston and Edison Companies.

The Boston *News Bureau*, a reliable financial publication, says:

The Thomson-Houston Company has sold about $500,000 more preferred stock, making the total amount now issued up to $3,000,000. No common stock has been sold. Europe has been a considerable buyer of the preferred stock of late.

The Thomson Houston Company can always see its profits months ahead, as it does not carry into its balances the profits from sales until collections have been made. As the business is always on a rising scale, the trades in hand show a larger profit than the sales of the past coming into the collections of the present.

A banker who has looked into the Thomson-Houston affairs, figures that the time is not far distant when Thomson-Houston common stock will be making earnings of 100 per cent., or $25 per share. The company has now about $5,000,000 due it upon contracts, and an expert estimates the loss in the collections of this amount at $75.

The Villard-Edison negotiations are not now looked upon as very important. Both the Edison and Thomson-Houston Companies have found the electric lighting field so large that they have abandoned the war policy, and are now getting good prices. The Sprague and Thomson-Houston people have also reached an understanding, we hear, by which too sharp competition in the electric railway field will be avoided.

Measurements of the overhead copper wire in the electric street railway system at Bowdoin square show no appreciable wear.

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This Company is the licensee of the
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FOR THE NEW ENGLAND STATES.
The office of the Parent Company is at 171 Broadway, New York, where the system may be seen in operation on a line to Boston.

Correspondence solicited; further information furnished; and exhibition at
113 DEVONSHIRE STREET, Room 21, BOSTON.

TREASURY DEPARTMENT, Washington, D. C., May 26, 1890. Sealed proposals will be received at this Department until two (2) o'clock, P. M., Friday, June 20 1890, for wiring the new U. S. Court House and Post Office, Pittsburgh, Pa., for a system of electric lighting. All particulars necessary in the premises can be obtained upon application to the Custodian, Custom House, Pittsburgh, Pa. The right to reject any and all bids, and to waive defects, is reserved. Proposals should be addressed to the Secretary of the Treasury, and endorsed, "Proposals for wiring Court House and Post Office, Pittsburgh, Pa." Acceptance of proposal dependent upon appropriation by Congress.
W. WINDOM, Sec'y.

FOR SALE.—Complete plant—Two upright Manning Boilers, two Ball engines, one Fort Wayne Jenny dynamo 1,000 light, one Goubert heater, two Worthington pumps, switchboard and all accessories. The above have been in use a short time only and will be sold cheap for cash.
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ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENTS OF THE UNITED STATES WERE ISSUED ON MAY 27, 1890.

428,586 Double pole switch; Geo. H. Alton, Lynn, Mass., assignor to the Thomson-Houston Electric Company, same place.
428,604 Process of manufacturing carbons; Chas. Heisler, St. Louis, Mo., assignor to the United Gas Improvement Company, Philadelphia, Pa.
428,616 Sliding clamp for electric welding apparatus. 428,617 Electrical apparatus for welding rings. 428,618 Transformer for heavy currents. 428,619 Method of welding rings by electricity. 428,620 Reactive coil; Hermann Lemp, Lynn, Mass., assignor to the Thomson Electric Welding Company, of Maine.
428,646 Machine for the manufacture of wax-coated tablets for graphophones; Chas. S. Tainter, Washington, D. C.
428,647 Turn-off for alternating current circuits. 428,648 Casing for induction coils; Elihu Thomson, Lynn, Mass., assignor to the Thomson-Houston Electric Company, of Connecticut.
428,649 Electric meter. 428,650 Alternating current magnetic device. 428,651 System of electrical distribution. 428,653 Guard wire protector and lightning arrester. 428,704 Electric switch. 428,705 Regulator for dynamo electric machine; Elihu Thomson, Lynn, Mass.
428,652 Incandescent lamp socket; Elihu Thomson and Geo. H. Alton, Lynn, Mass., assignors to the Thomson-Houston Electric Company, of Connecticut.
428,669 Electric locomotive; Edward Dummer, Newton, Mass.
428,676 Electric circuit closer for clocks; Henry C. Kan, Washington, D. C.
428,688 Electric low-water alarm; John Morehead, Detroit, Mich.
428,698 Single cord multiple switchboard system; Chas. E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place.
428,723 Electric light hanger; Clarence L. Jeffers, Manchester, N. H.
428,732 Electric motor and generator; Frank J. Sprague, New York, N. Y., assignor to the Sprague Electric Railway and Motor Company, of New York.
428,735 Brush holder for dynamo electric machines; Franklin A. Weller, Lynn, Mass.
428,742 428,743 Commutator collector or block for dynamo electric machines; Chas. F. Brush, Cleveland, Ohio.
428,745 Electric cable; Willard L. Candee, Brooklyn, assignor to the Okonite Company, New York, N. Y.
428,746 Galvanometer; Arthur E. Colgate, New York, N. Y., assignor to G. F. Otto & Sons, same place.
428,748 Device for maintaining electrical connection between separate railway trains; Donaphan M Fike and Joseph Huffman, Des Moines, Ia., assignors of three-fifths to J. A. T. Hull, R. B. Taylor, E. J. Fairall, R. M. DeWitt, W. W. Fink and A. J. Baker, same place.
428,750 Coin actuated attachment for phonographs. 428,751 Coin actuating attachment for phonographs; Louis Glass and William S. Arnold, San Francisco, Cal., assignors to R. W. Smith, same place.
428,781 Galvanic battery; John S. Nowotny, Cincinnati, Ohio, assignor of one-half to James J. Watrous, same place.
428,782 Electric motor or dynamo electric machine; Stephen M. Potter and Henry E. Morgan, Philadelphia, Pa.
428,810 Annunciator; Robert P. Garned, Norristown, Pa.
428,818 Attachment for telephone desks; Berthold Schram, Milwaukee, Wis.
428,828 Coin released telephone lock; Harry L. Cassard, Baltimore, Md.
428,834 Method of welding aluminium; Michael Emme, Atlanta, Ga.
428,854 Electric programme clock; John L. McCaskey, Wayneborough, Pa.
428,868 Solution for galvanic batteries; Edward M. Burt, Paris, Ill.
428,917 Electrically propelled vehicle; Arnold A. Ingraham, New York, N. Y.
428,929 Suspension hanger for electric lamps. 428,930 Suspension for trolley wires; Elmer P. Morris, Cincinnati, Ohio.
428,934 428,935 Electric switch. 429,049 Process of assembling secondary battery electrodes; James F. McLaughlin, Philadelphia, Pa.
428,942 Holder for electric arc lamps; Jacob Pawlowski, Cincinnati, Ohio.
428,970 System of circuits for electric semaphores; Frederic Stitzel, Louisville, Ky., assignor to the American Semaphore Company, same place.
428,979 Electric insulator; Geo. B Watson, Boston, Mass., assignor to the Gould & Watson Company, same place.
428,989 Globe for electric lamps; Wm. H. Wilson, New York, N. Y.
429,058 Device for suspending electric conductors; Homer I. Pierce, Lynn, assignor of one-half to Harry L. Pierce, Leominster, Mass.
429,067 Support for electric light and conductors; Charles H. Simmons, Brooklyn, N. Y.

Issued May 20.

428,454 Electric motor; William H. Chapman, Portland, Me., assignor to the Giant Electric Motor Company, Boston, Mass.
428,459 Process of welding metals electrically; Chas. L. Coffin, Detroit, Mich.
428,481 Electric motor or generator; Henry Groswith, Philadelphia, Pa., assignor by direct and mesne assignments of part to Chas. W. Kennedy and Ransom F. Rankin, both of same place.
428,499 Electric railway; Jerome B. Legg and John Nile, St. Louis, Mo.
428,540 Electric bath brush; Robt. E. Williams, Dallas, Texas.
428,545 Electric insulator; Emery Andrews, Kennebunk, Me., assignor to the Leatheroid Manufacturing Company, same place.
428,562 Electric communication with railway trains; Thos. J. Houck, Baltimore, Md., assignor of one-half to John T. Wood, same place.
428,564 Electric cut-out; Wm. J. Jenks, New York, N. Y.
428,573 Street motor; Wm. Simpkin, Richmond, Va., assignor to the Richmond Street Car Motor Company, same place.
428,574 Electrical converter. 428,575 Method of building electrical converters; Wm. Stanley, Jr., Great Barrington, Mass., assignor to Geo. Westinghouse, Jr., Pittsburgh, Pa.
428,576 Electric semaphore apparatus; Frederick Stitzel and Chas. Weinedel, Louisville, Ky.

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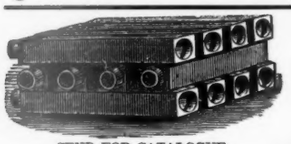
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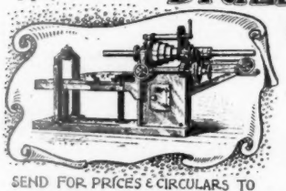
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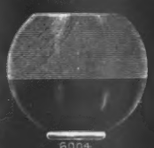
GLOBES  **SHADES**
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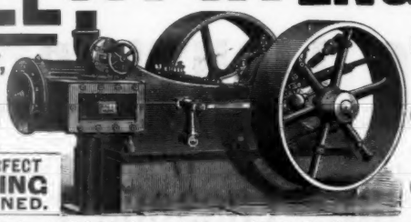

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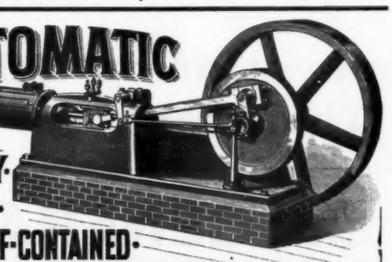

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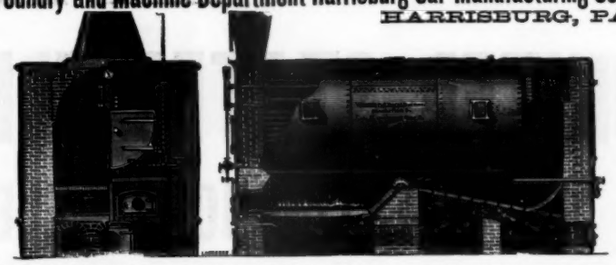

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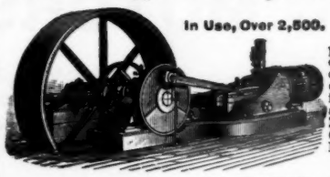

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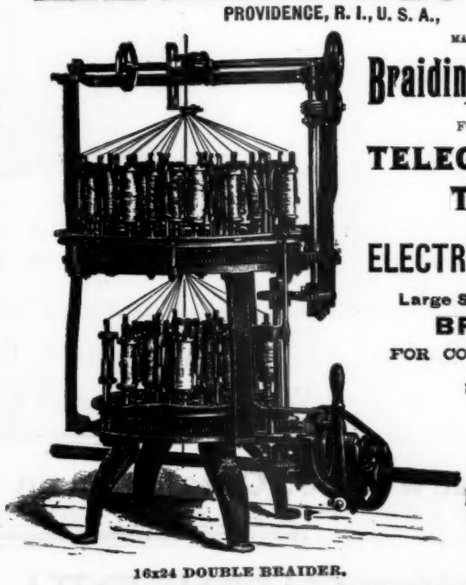

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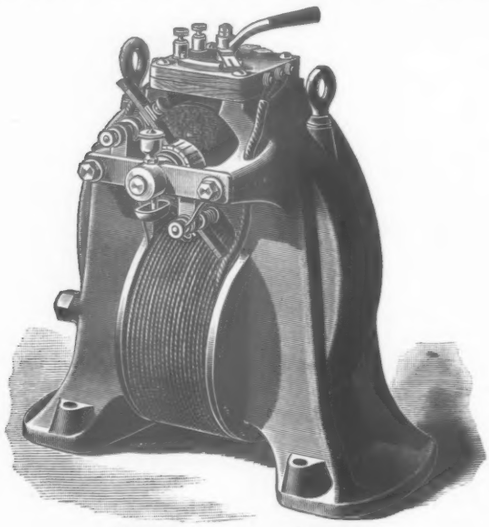

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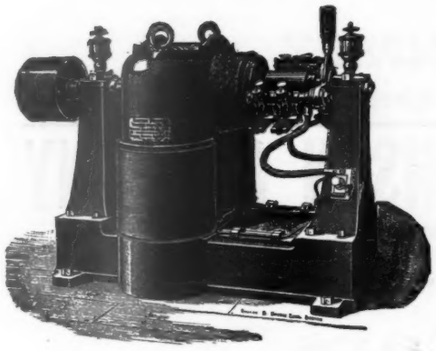

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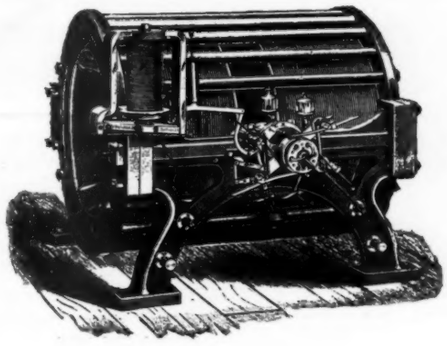

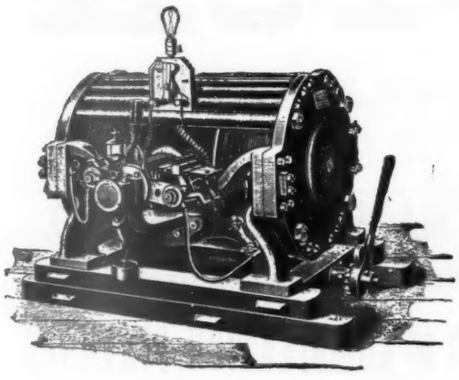

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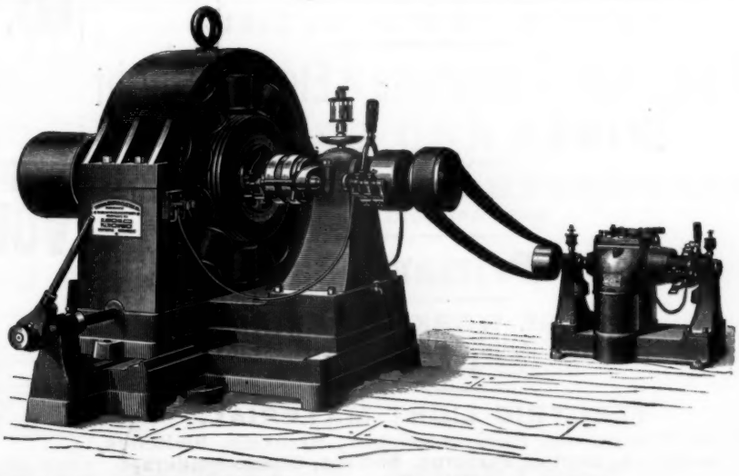

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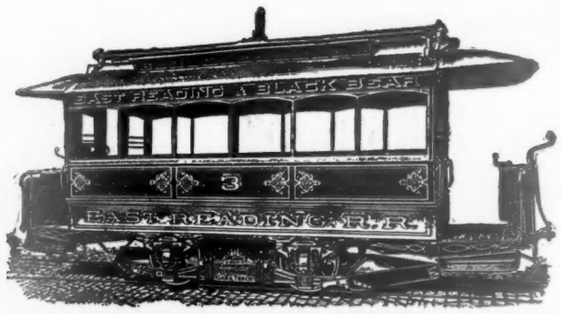

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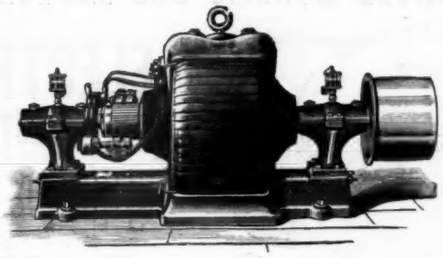

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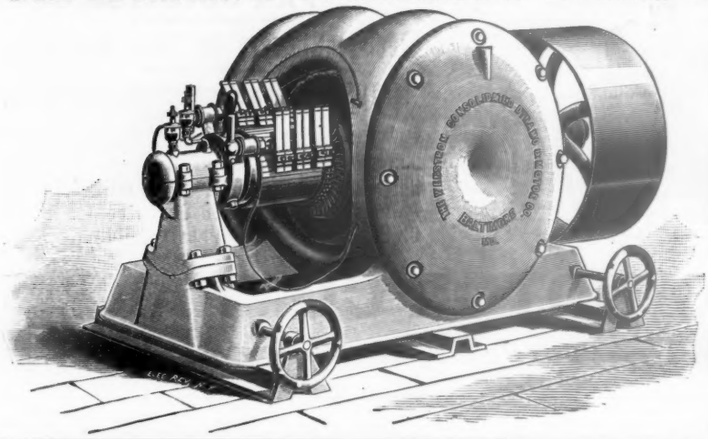

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List of all Street and Electric Railroads, with data.
List of all Telephone Stations.
List of all Electric, Gas and Street Railroad Associations, with Officers and Members.
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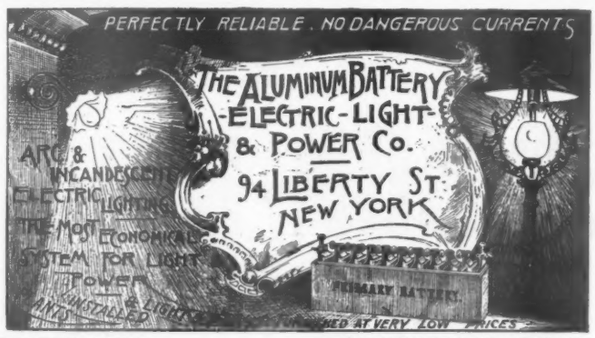

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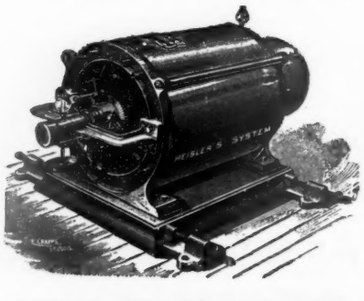

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CCCCCCCCCCC	8	10	.....	.....	6.5	1¼	5,000 FEET PER MINUTE.	530
	.....	.....	.....	.....	6.3	1½		530
	.....	.....	.....	35	8.0	2		530
	16	.....	.....	.....	12.0	2½		780
	.....	20	.....	.....	12.5	2½		780
	.....	.....	26	.....	13.0	2½		780
	20	.....	.....	.....	15.0	3		990
	.....	25	.....	.....	15.6	3		990
	.....	.....	33	.....	15.0	3		990
	.....	.....	.....	50	16.0	3		990
	28	.....	.....	.....	21.0	4½		1,360

LIST OF DYNAMOS IN STOCK.

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CCCCCCCCCCC	.....	35	.....	.....	21.0	4	5,000 FEET PER MINUTE.	1,360
	.....	.....	45	.....	21.0	4		1,360
	.....	.....	.....	70	21.0	4½		1,360
	40	.....	.....	.....	29.7	6		1,750
	.....	50	.....	.....	30.0	6		1,750
	.....	.....	64	.....	29.5	6		1,750
	52	.....	.....	.....	38.0	8		2,290
	.....	65	.....	.....	38.6	8		2,290
	.....	.....	83	.....	38.0	8		2,290
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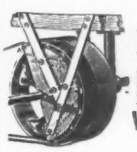

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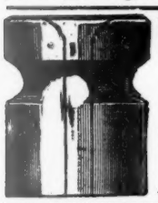

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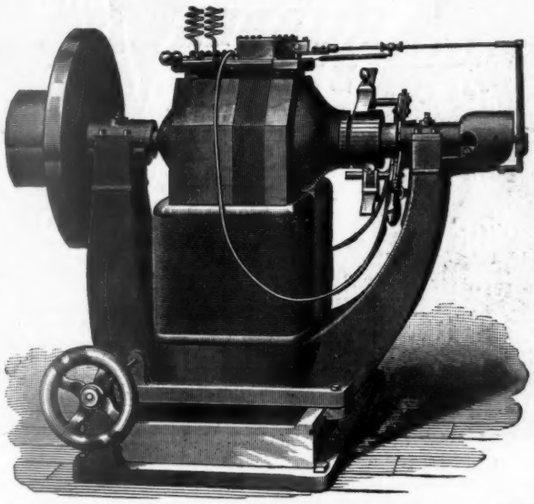

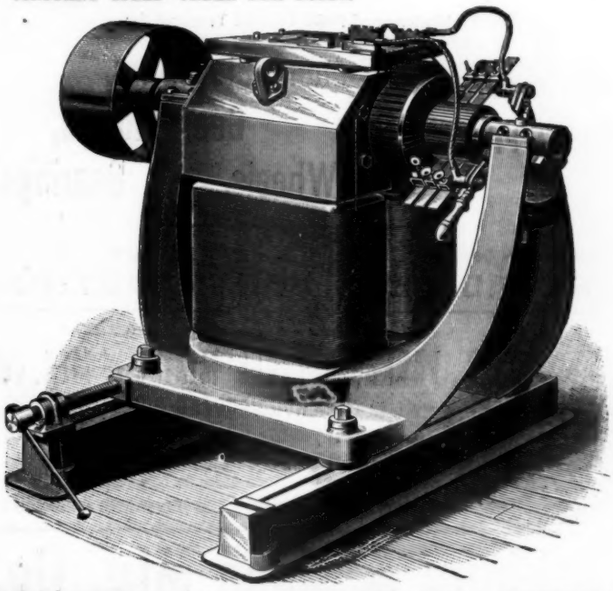

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FIG. 1.

Fig. 1 represents Copper Tee used for branching from main cables, as shown in Fig. 2.

FIG. 2.

Fig. 3 represents a Copper Sleeve used for straight connections for continuation of cables.

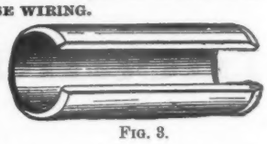

FIG. 3.

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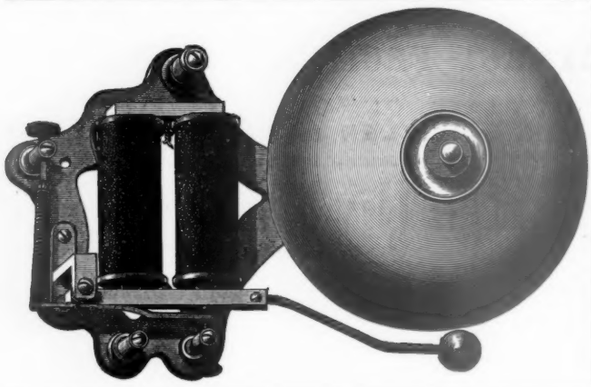

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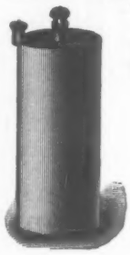

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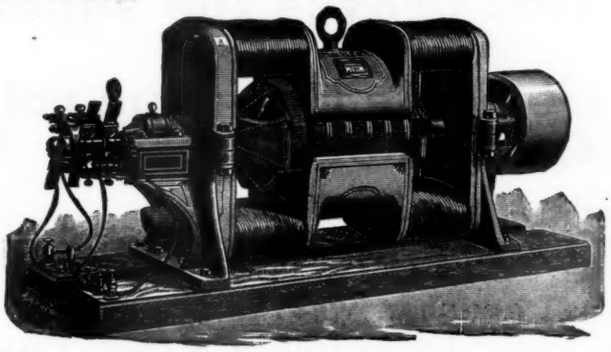

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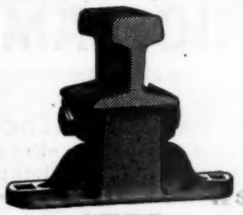

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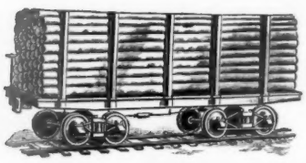

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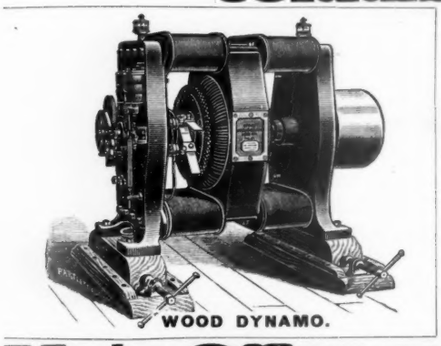

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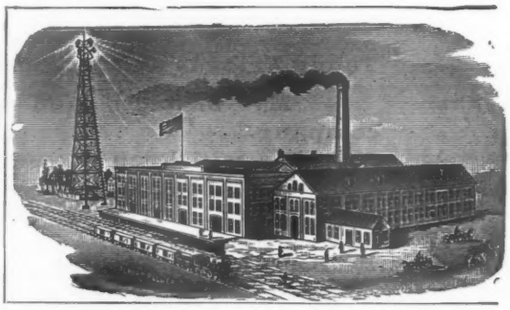

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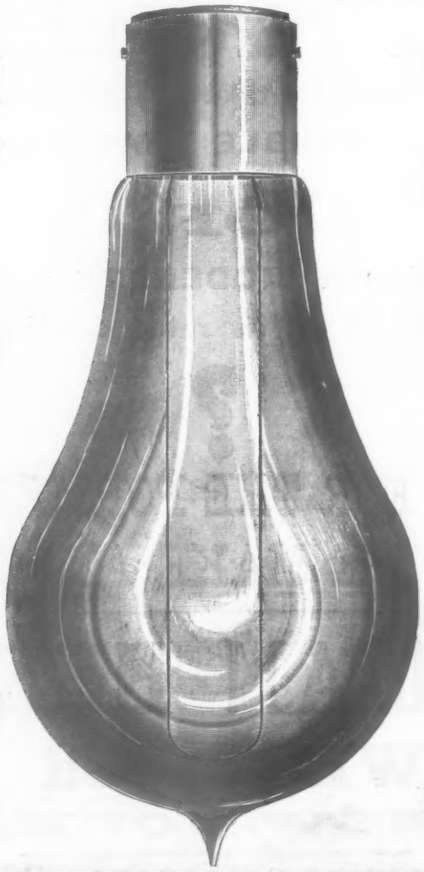

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